POWER

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An Epoch-Making Accomplishment

AS THIS is written, flags are flying, music playing and the New York crowds shouting their welcome to the man who proved the possibility of a non-stop flight from New York to Paris.

The world is justly keen with admiration for one who, full of confidence that the thing could be done, just went ahead and did it.

With no flourish of trumpets, with no crowding for a place in the limelight, with no haggling for terms and no bombastic announcement of what he was going to do, he slipped into New York and out again and landed on the one little spot in the world for which he started.

He had one motor of 200 horsepower. If it failed to make between three and four million revolutions without a stop in its run across the Atlantic, the result would have been almost certain death.

His feat has demonstrated not only his ability as a flyer, but the high degree of dependability which the high-speed internal-combustion engine has attained.

It took almost a century to develop the pulsometer of Savery into an engine that could turn the wheels of industry.

It is only about thirty years since Langley almost demonstrated the possibility of heavier-than-air flight.

The sky, seen from my window, is now dotted with planes in single flight and flotilla formation.

It is but a few years since the flying of the English Channel was hailed as an astounding feat. Today it is a part of a regular passenger service.

Two planes have now made the Atlantic flight without a stop, and two equally daring adventurers have attempted the voyage in the opposite direction with a less fortunate result.

On such bravery and skill depends the development of the possibilities of this new method of transportation and communication that reliable and portable power has placed at our command.

Who can predict the progress of another score of years?

F. R. Low

Utility Supplies Power, Heating and Process Steam

MODERN 6,000-kw. plant with all refinements of larger stations is expected to produce a kilowatt-hour for 14,300 B.t.u., when bleeding to central heating system and supplying process steam from evaporators. The rate increases to 17,500 B.t.u. when operating straight condensing at the most economical point. Economizers absorb heat in flue gas and combustion air is preheated by steam from evaporators. Underfeed stokers burn Illinois coal. Water walls protect the furnaces. Combination convection and radiant superheaters raise temperature of 400-lb. steam to 715 deg. F. Hydrojet sluicing system removes ash.

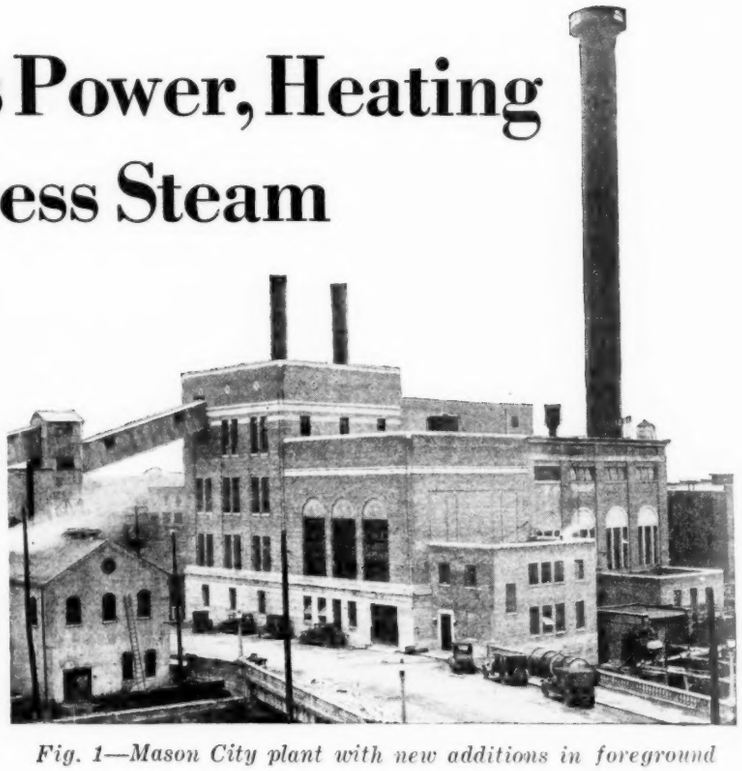

Fig. 1—Mason City plant with new additions in foreground

QUITE recently, the United Light & Power Company, of Davenport, had an interesting problem to solve, in enlarging economically the Mason City, Iowa, plant of its subsidiary, the Peoples Gas & Electric Company. The station is in the center of the cement and tile industry of the city, which, together with a packing plant, forms the bulk of the power load. Other services are the lighting of a growing city, the operation of a central hot-water heating system in the business district and the supply of 160-lb. process steam to near-by plants.

Naturally, the plant had been located in near proximity to the heating load and on a site that is now restricted to limited extension. Conservation of space, therefore, and improved economy were the guiding factors in the new addition that led to the adoption of 400-lb. boiler pressure, operation at high rating and the introduction of refinements at a cost approximating in total $150 per kilowatt. The supply of steam for process and for heating, and the correlation of a two-pressure plant introduced complications calling for ingenious solution.

Preliminary heat-balance estimates show that during the colder months with 1 in. abs. back pressure and when bleeding 34,000 lb. of steam per hour to the heating system, only 14,300 B.t.u. per net kilowatt-hour is chargeable to the generation of electricity. With a condenser pressure of 2 in. abs. caused by the warmer circulating water available during the summer, and no bleeding of steam for the heating system, the heat consumption at the most economical load increases to 17,500 B.t.u.

In the old plant are three turbine-generator units operating with a total rated capacity of 6,000 kw. Steam conditions at the throttle are 160 lb. pressure and 100 deg. F. superheat, the supply coming from six boilers of the Stirling type having an aggregate of 27,000 sq.ft. of surface, five being served by chain grates and one by a five-retort 29-tuyere underfeed stoker.

A study of load conditions indicated that a 6,000-kw. generating unit with a turbine large enough to produce 7,500 kw. would meet present needs and that one new boiler with a second in reserve, would supply the higher-pressure steam. To accommodate the new equipment, the building was extended, the 1,500-kw. generating unit removed, and turbines and boilers, new and old, placed in line. The intention is to reserve the older section of the plant for stand-by service until increasing load makes it desirable to replace the old units with modern equipment.

With two different pressures the feed water and steam systems were interconnected through reducing valves, so that in case of necessity the new plant may supply the old. Suitable relief valves protect the old piping against the higher pressure and a jet-type desuperheater reduces the superheat from approximately 250 to the 100 deg. F. used in the initial plant. Although the old header will be kept hot to supply certain auxiliaries, it is anticipated that the older section of the plant will come into operation only at rare intervals, such as might be occasioned by the shutting down of the new turbine.

Two cross-drum water-tube boilers, designed for a pressure of 450 lb., were installed in order that the 400-lb. operating pressure might be available at the superheater outlet. Combination convection and radiant superheaters are used to give a total steam temperature approximating 715 deg. F.

Conservation of space and initial investment being the other factors determining the design, it was decided to operate the boilers normally at 350 per cent rating, with sufficient reserve stoker capacity to run up to 510

per cent. Drawing upon past experience, underfeed stokers were selected for such service. The fuel to be used is Illinois coal, as it can be obtained at a lower cost per ton than suitable Iowa coals. Six retort stokers, 33 tuyeres long, driven by hydraulic cylinders serve the boilers. The pumps supplying the water for the hydraulic drive are interconnected so that either pump may drive either stoker. A grate area bearing a ratio to the steam-making surface of 1 to 32.4 indicates the large coal-burning capacity provided. A feature of the stoker is the deep ashpit, equipped with clinker rolls 18 in. in diameter and water-back protection for the brickwork at the rear.

Ashes Removed by Hydraulic Sluicing

From the rolls the ashes drop on sloping cast-iron feed plates from which they are washed by water jets into the main discharge trough of an ash-sluicing system. The trough is made of concrete protected by cast-iron liners. At certain intervals booster nozzles are installed that keep the ashes in motion and finally discharge them into a pit outside the building. From the pit a clamshell bucket operating from an overhead trolley loads the ash into railway cars. The water in the pit is conserved for recirculation by drawing it through a slotted cast-iron strainer and a series of baffles by means of a specially constructed pump with impellers of cast iron to reduce the corrosive effect of the ash.

By setting the center of the boiler drum 29 ft. 2 in. above the base line of the stoker, it was possible to provide a furnace having ½ cu.ft. per sq.ft. of steam-making surface, thus giving the volume needed to operate at ratings of from 300 to 500 per cent. The side walls are protected by water-cooled surfaces made up of inclined headers and vertical elements consisting of 4-in. steel tubes covered with bare cast-iron blocks. On each side there is 225 sq.ft. of surface. The tubes curve through the wall to headers on the outside which are connected separately to the boiler drum. The rear wall is occupied principally by the radiant superheater and the water-backs previously mentioned, while the front wall is left unprotected, so that the refractory may accelerate ignition.

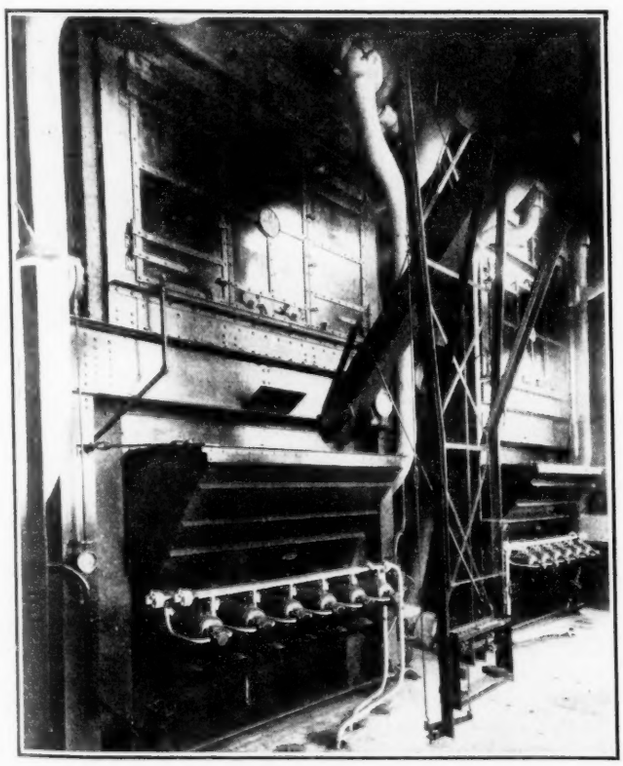

Fig. 2—New boilers equipped with underfeed hydraulic stokers

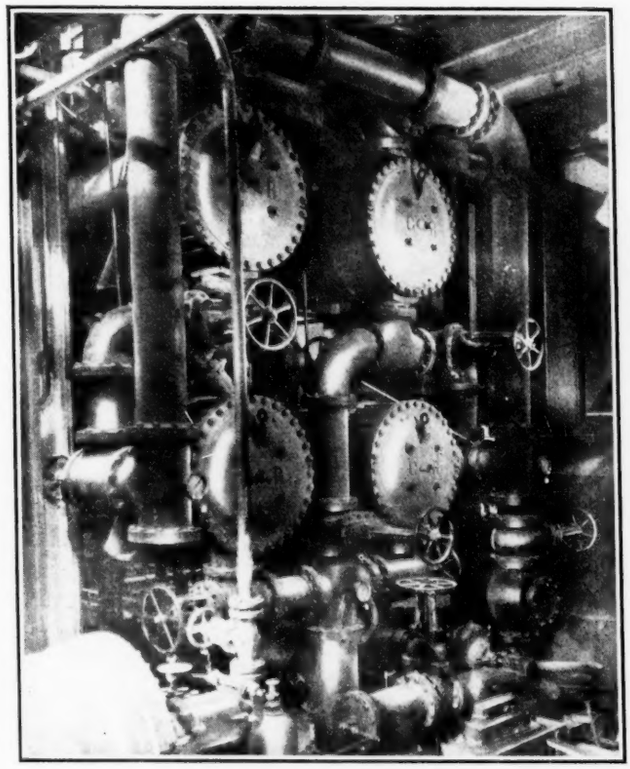

Fig. 3—Heaters for hot-water heating system

Recovering the Waste Heat

With flue gas leaving the boiler at 600 deg. F. and above, the question of conserving this waste heat had to be considered. Commercial economy would not justify both air heaters and economizers. Lack of space prohibited the large air heater that would have been needed, if used alone, and besides, the air temperatures would have been higher than desired for operation in connection with underfeed stokers. Therefore, steel-tube counterflow economizers with 69 per cent as much surface as that in the boilers were installed to reduce outgoing flue-gas temperatures to between 350 and 375 deg. F., depending on the load. However, the advantages to be obtained from preheating air for combustion were not overlooked, as an air heater was installed in the main air duct to the stoker, which, by condensing the steam from the evaporators raises the temperature of the air to 260 deg. F.

Through a grating in the boiler-room floor the combustion air is drawn into the basement and by a forced-draft fan pushed through the air heater to the stoker. The fan for each boiler is driven by a variable-speed slip-ring motor regulated by a 13-point hand controller, located beside the boiler control panel. Additional control may be effected by regulating the damper in the air duct from a floor stand. Similar control at this central location is provided for the induced-draft fans,

which are on the economizer floor above the boilers. These fans, driven by slip-ring motors, will provide an 8-in. suction at 690 r.p.m.

Reference to the sectional elevation of the plant, Fig. 4, will show that provision has been made to bypass the economizer through a flue leading from the top of the uptake directly to the stack. This may be used when the boiler is operating at low ratings or during banking periods, and the fan shut down entirely. For operation at extreme rating, provision is made to bypass part of the gas around the economizer, the connection for this purpose being shown plainly in the drawing. This bypass will not be used until operation exceeds 450 per cent of rating, but it permits the use of a fan and motor of smaller capacity than would be needed to meet the full requirements.

Lack of space on the plant site made it desirable to combine the coal receiving facilities with those of a gas

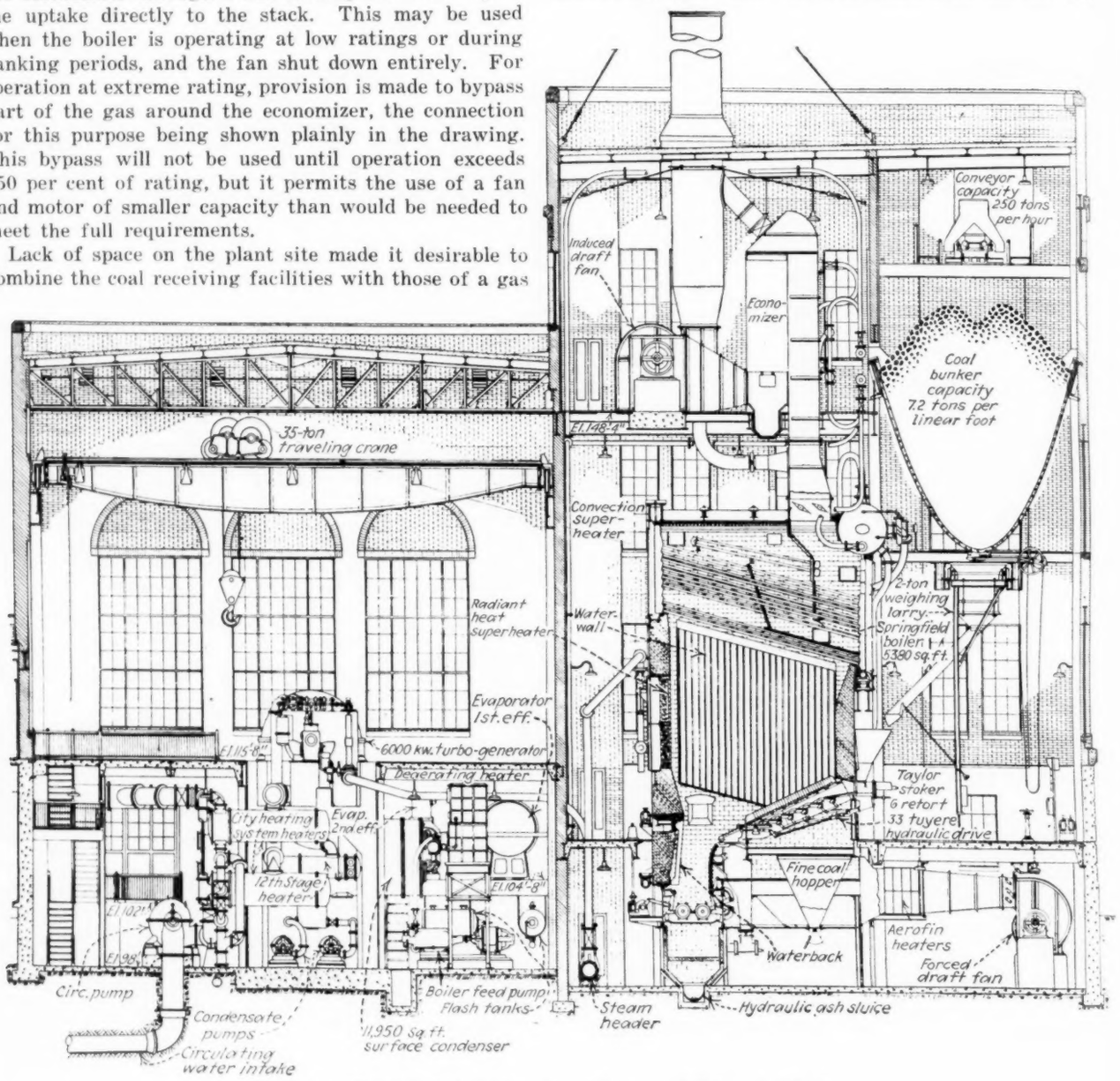

Fig. 4—Sectional elevation through new addition to plant

plant across the street owned by the same company. The coal for the plant or the coke for the gashouse may be discharged from hopper-bottomed cars into a concrete track hopper. Transfer is made by an apron conveyor to a hopper over a rigid hammer crusher which discharges directly to a belt conveyor under the crusher. This latter carrier elevates the coal and discharges it to a second belt conveyor passing across the street to the new and old bunkers serving the boilers, distribution being effected by a traveling tripper. Coke or coal for the gashouse is bypassed around the crusher and from the first belt conveyor is delivered to a scraper conveyor and distributed to bunkers in the gashouse. In the boiler house coal is transferred from the bunkers to the stokers by a two-ton traveling weigh larry, motor driven, but with the control within reach from the floor.

The condensate pump first passes the water through a closed heater receiving steam bled from the twelfth stage of the turbine. The flow then continues to a deaërating open heater fed with steam from the seventh stage of the turbine. In this heater all drips from the plant are collected. The feed pumps draw from the open heater and force the water on through the economizers to the boilers. To take care of irregular flow, a surge tank, located just beneath the boiler-room roof, has been connected into the system between the condensate pump discharge and the twelfth-stage closed heater. The overflow is piped to a pure-water storage tank in the basement. Whenever the amount of condensate is below requirements, this supply of pure water is pumped back under float control to the surge tank.

At the boilers a two-header feed system has been arranged, so that any section of the piping can be bypassed. Feed-water regulators, in conjunction with ex-

cess-pressure regulators, control the flow to the boilers. The excess-pressure regulator is placed before the economizers, so that the latter need not be subjected to the full fluctuation in pressure at the pump. From each header an emergency hand feed bypassing the economizer enters the opposite end of the boiler drum from the primary feed. Two six-stage motor-driven and one five-stage turbine-driven boiler-feed pumps have been provided.

Process Steam from Evaporators

Makeup for the plant is considerable, owing to the fact that steam at 160-lb. gage pressure must be supplied to adjacent plants for process work from which there is no return. To supply some of the auxiliaries, steam at low pressure must be maintained in the header in the old section of the plant. This process steam is generated by a specially designed evaporator that also provides evaporated makeup water. The outgoing process steam is supplied from the two first effects which receive high-pressure steam from the boilers after it has passed through a desuperheater. A small second effect supplies the makeup to the boiler-feed system. It is the vapor from this second effect that is condensed in the air heaters. Drips from the air heaters and the evaporator are flashed into the seventh-stage bleeder line and the condensation drained into the open heater. Water for the evaporator comes from a hot-process softening system forming part of the old equipment of the station.

Another service introducing complications that were solved in a most satisfactory manner is the hot-water heating system serving the central business district of the city, which, at the present time, has over 200,000 sq.ft. of radiation. Originally, the water of the system was heated in a large open heater taking exhaust steam from the auxiliaries and some steam bled from the old turbine units. Considerable trouble was experienced from corrosion in the pipe lines, and as it was desired to return all possible condensation to the boiler plant, the open heater was replaced by four closed heaters. The first two of these heaters receive steam bled from the seventh stage of the new turbine unit, and the second pair of heaters receive steam from the turbine-driven pump circulating the heating water and from the turbine-driven boiler-feed and condenser circulating pumps, the amount varying with the water temperature desired to meet the weather conditions.

With full electric load on the main unit enough steam can be bled to heat the water, but on light loads it is necessary to supplement with exhaust steam, and for emergency use a live steam connection also is provided. Several turbine-driven auxiliaries are installed in the plant, so that the amount of the exhaust steam available can be varied within wide limits. The practice, however, is to use as much bled steam as possible, as this reduces the condenser loss and conserves the condenser circulating water.

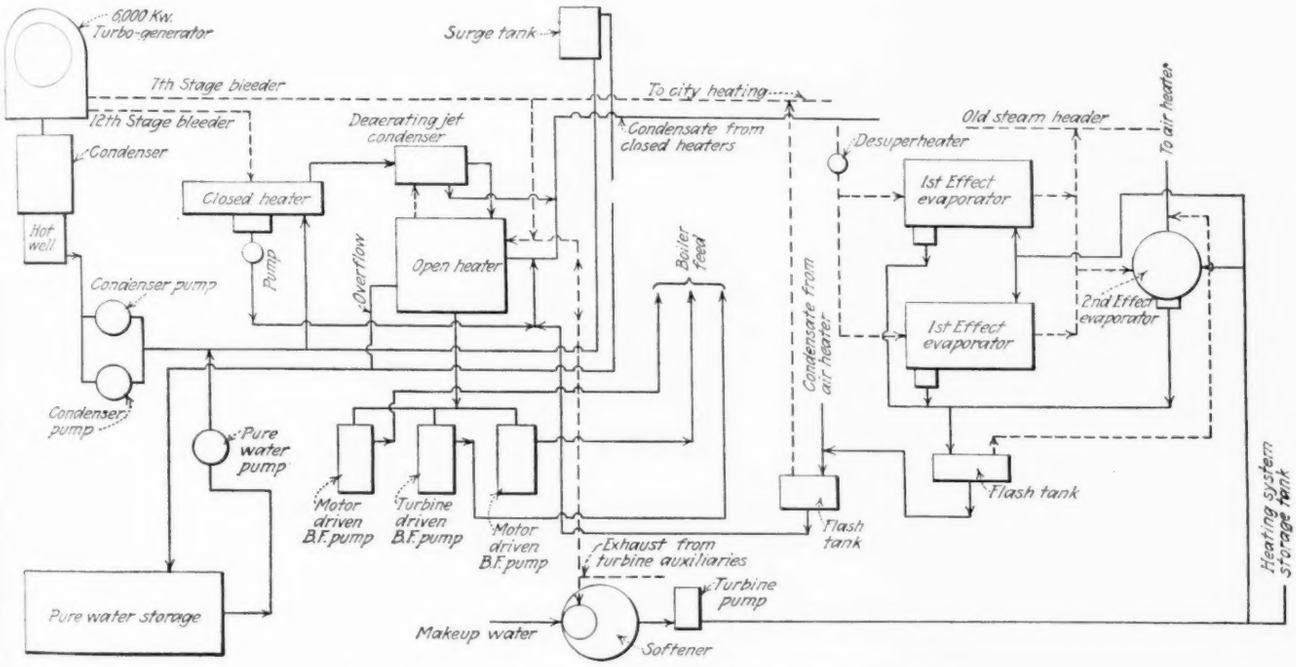

Fig. 5—Water flow diagram for new section of plant

In selecting the main turbine, it was desired to get a machine large enough to carry 7,500 kw. as maximum load and at the same time to take advantage of the improved economy available from a speed of 3,600 r.p.m. A 10,000-kw. turbine was considered, but the speed in this case would have been 1,800 r.p.m. Operating straight condensing against 2 in. abs. back pressure, the water rate on the turbine selected is 10.35 lb. per kw.-hr., and at 1 in. back pressure, 9.75. Including the steam bled to the heating system, amounting to 34,000 lb. per hour under a definite condition, the rate increases to 14.5 lb. per kw.-hr. For the old turbines the water rates are approximately double these figures, so that economy dictates the use of the new turbine to the maximum extent.

The condenser is of the surface type having a divided water box with two inlets and two outlets, so that either half of the surface may be cleaned during operation

The circulating pump has a dual drive consisting of a turbine and reducing gear at one end and a variable-speed motor at the other. This pump has been designed to operate against sufficient head, about 47 ft., to spray the water when necessary, a spray pond being one of the heirlooms from the older plant. A rotative dry vacuum pump was selected for air removal and hotwell pumps driven by constant-speed induction motors were provided in duplicate.

Circulating condenser water is drawn from Willow Creek, whose flow is erratic and during the dry months of the year has been so limited that it was necessary to build a dam across the stream to conserve the supply. Even then the initial plant required a spray pond, as the water from the condensers was discharged below the dam.

A marked saving in cooling water was effected by building a new dam a block down from the plant and directing the discharge from the condenser to a point just above the dam. With this arrangement any overflow will take the hot water, and with no water flowing over the dam, the hot water must work its way back for a distance equivalent to a city block, so that it becomes thoroughly mixed with the storage water in the creek before being used again in the condenser. With the new system sufficient water will be available for the greater part of the year and the spray pond will be used only in the summer months, if at all.

Engineering and construction work has been carried out under the immediate supervision of the United Light & Power Engineering & Construction Company, with headquarters at Davenport, Iowa, of which B. J. Denman and G. T. Shoemaker are president and vice-president, respectively. Operation is under the direction of F. J. Hanlon, of the People's Gas & Electric Company, of Mason City.

PRINCIPAL MECHANICAL EQUIPMENT—1926 ADDITION TO MASON CITY PLANT

GENERAL

Location of plant	Mason City, Iowa
Character of service	Light and power
Capacity, new addition, kva	7,500

BOILERS

Manufacturer	Springfield Boiler Co.
Type	2 water-tube, cross-drum
Steam-making surface per boiler, sq.ft.	5,380
Furnace volume, cu.ft.	2,690
Furnace volume per sq.ft. grate area, cu.ft.	16.2
Soot blowers	Diamond Power Specialty Co.
Superheaters, convection and radiant heat	Power Specialty Co.
Surface, sq.ft.: convection 655; radiant 88; total	743
Ratio superheater surface to steaming surface	1 to 7.24
Water walls and water backs, Foster high pressure	Power Specialty Co.
Surface per wall, 225 sq.ft.; total surface, sq.ft.	450
Waterback, surface, sq.ft.	69

STOKERS

Manufacturer, 6-retort, 33-tuyere	American Eng. Co.
Type	2 Taylor underfeed
Grate area, projected, sq.ft.	166.3
Stoker and clinker grinder drive	Hele-Shaw hydraulic

ECONOMIZERS

Manufacturer	Power Specialty Co.
Type	2-steel-tube counterflow
Surface of each, sq.ft.	3,696
Ratio economizer surface to boiler surface, per cent	69
Induced-draft, 2 fans	Jeffrey Mfg. Co.
Capacity at 410 deg. F. and 7.5 in total pressure, cu.ft. per min.	57,000
Drive, wound-rotor motor, 690 r.p.m., hp.	125
Forced-draft, 2	Jeffrey Mfg. Co.
Capacity at 110 deg. F., 9-in. static pressure, cu.ft. per min.	36,000
Drive, wound-rotor motor, 1,750 r.p.m., hp.	75

TURBO-GENERATOR

Manufacturer	General Electric Co.
Turbine, 3,600-r.p.m., single-cylinder, 15-stage.	
Rated capacity of turbine, kw.	7,500
Generator	7,500-kva., 13,200-v., Y-con. 3-ph., 60-cyc.
Generator ventilation	Closed system, G. E. U-Fin air coolers
Direct-connected exciter	37 kw., 125 volts

CONDENSERS

Manufacturer	Worthington Pump & Machy. Corp.
Type, horizontal	2-pass, divided water box
Surface	11,950 sq.ft.
Circulating pump, one 20-in. double-section volute capacity, 11,200-g.p.m. at 47-ft. head.	
Drive, 175-hp. Curtis steam turbine, and 200-hp. wound-rotor motor.	
Speed, r.p.m.	695
Dry vacuum pump, one Laidlaw feather valve, single-cylinder, 2-stage	
Drive, 25-hp. motor, close-belted	900 r.p.m.
Hotwell pumps, two, 4-in. hor. 2-stage, 200 g.p.m., against 150-ft. head.	
Drive	25-hp.-motor, 1,755 r.p.m.

PUMPS

Manufacturer	A.S. Cameron Steam Pump Works
Boiler feed, three; one 5-stage, two six-stage	
Capacity against head 525 lb. per sq.in., gal. per min.	250
Drive of 5-stage pump, 150 hp. G. E. steam turbine; control, Mercon excess-pressure regulator	
Drive of 6-stage pumps, 150-hp. wound rotor motors	
House service, 2 single-stage, double-suction, 300 g.p.m., 231 ft. head.	
Drive	Constant speed, induction motor, 1,750 r.p.m.
Pure water	1-single-stage, double-suction, 150 g.p.m., 100 ft. head.
Drive	Constant speed, induction motor 1,750 r.p.m.
Control	Float at surge tank
Circulating-pump heating system, one 8-in., single stage, double-suction	Capacity 3,300 g.p.m., 208 ft. head
Drive	240 hp., 2,400 r.p.m. Westinghouse turbine

HEATERS

City heating, 4 two-pass, closed	Griscom-Russell Co.
Surface per heater, sq.ft.	1,154
Feed water, one 6-pass, closed heater and one open deaerating heater	
Capacity, lb. per hr.	82,000

EVAPORATORS

Manufacturer	Griscom-Russell Co.
Type, 2-high press., horizontal, steel, self-scaling, first effect; one low-pres., vert., c.i. self-scaling, second effect	
Capacity, 7,500 lb. per hr. steam at 158-lb. gage to other plants and 4,352 lb. per hour makeup condensed in air heaters	

AIR HEATERS

Manufacturer, two, steam, fin-tube	Aerofin Corp.
Surface, per heater	2,500

COAL-HANDLING EQUIPMENT

Manufacturer	Jeffrey Mfg. Col
Capacity, tons per hr.	75
Crushing equipment	Rigid hammer crusher with apron feeder
Conveying equipment	Belt conveyor with traveling tripper
Parabolic bunker, 300 tons	Brown Hoisting Mach. Co.
Traveling weight larry, 2 tons	Brown Hoisting Mach. Co.

ASH-HANDLING EQUIPMENT

Manufacturer	Allen-Sherman-Hoff Co.
Type	Hydrojet
Pumps for sluicing water, 2-A.S. Cameron, 1,200-g.p.m., 200-ft. head, 1,750 r.p.m., single-stage, driven by 75-hp. motors	

HIGH-PRESSURE PIPING AND VALVES

Pipe	Lap welded steel
Type joint	Midwest Piping and Supply Co.
Gate and globe valves	Lunkenheimer Company
Boiler-stop check valves	Schutte & Koerting Co.
Boiler-feed check valves, poppet type	Edward Valve & Mfg. Co.
Boiler blowoff valves, tandem	Yarnall-Waring Co. / Lunkenheimer Company
Boiler feed regulators, Copes	Northern Equipment Co.
Excess-pressure regulators, "Mercon"	D. H. Skeen & Co.

MISCELLANEOUS

Revolving screen	Chain Belt Co.
Boiler and engine room instruments, Bailey Meter Co., Foxboro Co., American Schaeffer & Budenberg Corp., Taylor Instrument Co.	
Heat insulation	Phillip Carey Co.

Should you take

A Temporary Engineering Job?

Part II—The Bright Side

By H. M. FRIEND

MANY a man owes his success in life to the start he obtained from a temporary job. Perhaps it pulled him out of the rut that leads to a stone wall at the end of a blind alley. Or perhaps he absorbed some of the bigness that permeates the air of spectacular engineering projects. To know that your small part has helped in another conquest of man over nature is bound to put its impress on your life. Part I, in the previous issue, covered the darker side of the temporary engineering job. Here is the bright side.

THERE is always the possibility that the temporary job will lead to something permanent. You may fit into the organization of the company or they may get other jobs and retain you. Then, if the work is being done for a client, you have an excellent opportunity to study his organization and find a place for yourself. There are usually other contractors who are working for this client and you have opportunities in that direction. Perhaps the work has taken you into another city and state, and thus you have additional territory in which to search.

One of the most desirable things about temporary jobs is the excellent experience that usually goes with them. They are often important pieces of engineering work. On many of them you are thrown largely on your own resources, especially so where there is not a large permanent organization and where most of the engineers are, like yourself, recruited for this particular job.

I have in mind a temporary job in connection with a large hydro-electric development. There the engineers were few and far between, and all were squarely on their own resources. Too much work had to be done and the physical distances were too great to keep in close touch with headquarters.

Besides the particular job they handled, which was the finest kind of experience, every engineer was needed on the acceptance tests of the main turbines and generators. Engineering work like this is of such a spectacular nature that it is never forgotten.

You gain considerable engineering knowledge from the men with whom you are thrown in contact. Because of everyone being away from home, you are bound closer together and you can keep pretty well in touch with the important things that develop in other parts of the job. You often meet interesting personalities and men who have been on engineering jobs all over the world. During the noon hour you may hear discussed some striking experiences on a Japanese hydro-electric development, a construction job in the Canadian Northwest, or the building of some great metropolitan power plant. Few permanent positions in one location have such an interesting group of engineers, and this is no small matter to be overlooked. A temporary job always seems to have men of this type.

Then there is the possibility of obtaining another job through friends made this way, or through the leads they give you. For example, on the development referred to, one of the engineers got a place with a construction project in South America and through him a number of his civil-engineer friends obtained positions.

The salary received is usually, and rightly so, somewhat higher than on permanent jobs. Much of this work is done cost plus, so your company will be more likely to give you a good salary. Then they are more anxious than usual to keep their men satisfied in order to hold them to the end of the work.

Expenses are almost always paid, and when the work is in some out-of-the-way place you can save a considerable part of your salary.

During the noon hour you may hear discussed some striking experiences

There is a feature not to be overlooked and that is the advertising value you get from having been on some well-known project. Many a man has owed his success in life to the start obtained from a prominent temporary job. This is especially true with lawyers where a single famous case has brought instant recognition.

The time element of a temporary job is often a great help. You have been out of work and have put out many lines. You take a temporary job and these lines have time to develop before the work is over. It is also

the general opinion that while you have one job you will be more favorably considered for another. Certainly, you are in a better position to hold out for a good salary.

I know one engineer who, during the 1914 panic, was caught in New York City without a job. Conditions were especially bad there, and the only thing he could find was a position requiring a civil-service examination. He took this, but so much time elapsed before the appointment was made that he went back to his home town and completed a temporary job before he obtained the permanent one.

Temporary jobs often put a touch of romance and adventure into one's life. There is a certain thrill of accomplishment in doing your bit on some great project and seeing each day the gigantic walls of concrete grow higher and higher. Life in a construction camp is quite an experience to one who has gone day after day for years to the same office. Just as important work may be done in that permanent office, but that touch of adventure is not there.

There are some funny ramifications connected with temporary jobs, and you may have just such an experi-

Christmas time at the construction camp

A wreath of holly on the door of an engineer's shack gives a touch of home to the scene.

ence. On a certain construction job there were a lot of young engineers employed. The work lasted for a couple of years and they were all getting good salaries and living costs were low. A few miles away was a small Southern town with the usual abundance of attractive country girls and not enough beaux to go around. To make a living, most of the ambitious young men went to the cities and those that were left had small earnings as soda dispensers, drug or shoe clerks.

The combination of the lonely young engineers at the construction camp and a few miles away the attractive country girls without enough local beaux, was too much for human nature to withstand. As a result practically every young engineer took home—besides the engineering experience of the big job—a blushing bride. It was frankly admitted by the older women of the town that the construction camp had been one of the greatest boons for the girls of that town that had ever happened. I have heard the same story from other jobs.

We have taken up some of the disadvantages and some of the advantages of a temporary job; now let us try to fit your particular case to them.

The main consideration, of course, as to whether or not you should take a temporary job is your individual circumstances. You probably belong in one of three classes: (1) You are out of work; (2) you are dissatisfied with your present position, dislike your work, gaining little experience, future prospects poor, or pay unsatisfactory; (3) you are holding a permanent position and are satisfied with work, prospects and pay.

If you are out of work, you will be the most interested in the temporary position and will most likely go after it tooth and nail. When unemployed, you are naturally less discriminating. As you are aggressively on the lookout, you are likely to hear about the job sooner than when you are employed. The chances of your getting the job are better when you are idle, provided, of course, that your unemployment is not due to a serious failure and with a poor record back of you. You have the time to follow the job personally, which the employed man hasn't.

You sometimes run squarely into a job like this when you are unemployed. The morning you drop into the office of the employment agency, an out-of-town representative is there to obtain a man or you hear of a company that has secured a construction contract and the very day you call they need a man.

One advantage you have is that you can begin work on much shorter notice than the man who is already employed. He usually wants a few days to think it over and to discuss the matter with his employer. Then he generally has to give two weeks' notice before leaving; the unemployed man can often start the following morning. This is frequently a great advantage, as there is usually a great rush of work and a man is needed at once.

If you belong to the second group—employed, but dissatisfied—the matter requires more discrimination. You are anxious to make a change, but what you want is a permanent position with better work, better opportunities and better pay.

You should realize, however, that the temporary job offers you an opportunity of getting out of your uncomfortable position and that there is always the possibility that it may lead to something permanent. It is much better to make a move into a temporary job than to continue in a rut.

If you are in the third group—are satisfied—you are probably not interested in a temporary position unless it comes to you with an offer of a much bigger salary, or unless you are unusually ambitious and see in it an avenue leading into higher things.

Sometimes a leave of absence from your permanent position can be arranged. Your company may even encourage it, saying that the added experience will increase your value to them and your chance of promotion.

In some companies, however, it works out quite differently. On your return you are eager to put to use your additional experience only to find yourself curbed by some unsympathetic executive or by departmental red tape. Perhaps you have breathed too deeply of the breath of freedom and of engineering experience and can no longer return to your gilded cage in which the gilt seems to have all worn off. If you are convinced that you are bucking up against a stone wall at the end of a blind alley, the best course is to leave as soon as possible. You can then put your best efforts into securing a place more akin to your ideals.

Summing up, then, the question is a matter of your personal circumstances, your ambitions and what the job itself has to offer.

How To Figure the Size and Number of Safety Valves

HAS your boiler installation sufficient safety valve relieving capacity? Perhaps the boiler steaming capacities have been increased and additional valves are needed. This article gives a general method for answering this question.

EVERY boiler installation presents a problem of safety-valve capacity. Many plants have increased the steaming capacity of their boilers by replacing old equipment with modern stokers or pulverized fuel. These increases require additional relieving capacity, and thus the safety-valve problem is not confined to new installations.

The problem divides naturally in two main considerations—first, a determination of the maximum steam generating capacity of the boiler, and second, the number and size of safety valves required to relieve this amount of steam.

A number of empirical factors are given in various handbooks and boiler codes designed to assist in esti-

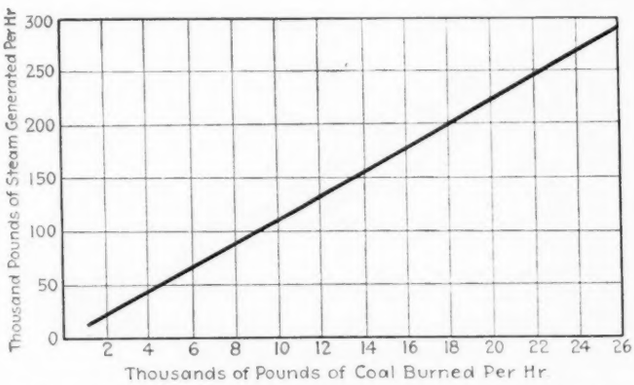

Fig. 1—Values given by this curve are based on coal of 14,500 B.t.u., 85 per cent boiler efficiency, and 1,100 B.t.u. absorbed per pound of steam

mating steam output from the boiler evaporative surface. Boiler capacities found from these are the minimum for which relieving capacity must be provided. However, since many of these factors are based on older practice, present high rates of evaporation make it unwise to use them, and calculations of steaming capacity should be based upon a more fundamental consideration.

A better method of estimating steaming capacities is based on the capacity of the fuel-burning equipment, which is either known or can easily be determined. From the fuel burned per hour in a boiler furnace the heat liberated can be determined by multiplying by the heat value of the fuel. In this calculation it is customary to assume that the highest grade of fuel of the type considered will be burned. For example, when burning bituminous coal, a heat value of 14,500 B.t.u. per lb. should be used. The heat absorbed by the water in the boiler is found by multiplying by boiler efficiency, which, if assumed to be 85 per cent, will be well on the safe side.

To calculate accurately the pounds of steam evaporated, it is necessary to determine the heat absorbed per pound of steam, and to do this the condition of the steam leaving the boiler and the temperature of the entering feed water must be known. In case these data are not available, a fair estimate can be made by assuming 1,100 B.t.u. as the heat absorbed per pound of steam. Dividing the maximum heat absorbed in the boiler per hour by 1,100 B.t.u. will result in the maximum pounds of steam the boiler is capable of generating. Fig. 1 shows the pounds of steam that can be generated from various amounts of coal burned based on the conditions assumed.

In most states boiler regulations require that sufficient relieving capacity shall be provided to discharge all the steam generated without allowing the boiler pressure to increase more than 6 per cent above the allowable working pressure. It is also required that a boiler capable of generating 2,000 lb. of steam per hour shall have two or more safety valves. These requirements vary in different states and cities, and it is advisable to consult the local code before a safety-valve installation is made.

Size and Number of Valves

For the purpose of estimating capacity, a safety valve may be considered as a nozzle with a throat area equal to the annular area between the valve seat and disk when the valve is open. The steam flow through such a nozzle may be determined by using Napier's formula:

$$E = \frac{AP \times 3{,}600}{70} = 51.43\,AP \qquad (1)$$

where E is discharge in pounds per hour, A is area of annular opening in square inches, and P is boiler gage pressure +14.7 lb. per sq.in. Experiments have shown that the actual steam deliveries of safety valves are 92.5 per cent of the values obtained from the foregoing formula.[1]

The annular area between the seat and disk depends on the lift of the disk, on the inside diameter of the valve seat and on the angle of the seat; if the seat is flat, the area equals $\pi \times D \times L$, where D is the inside diameter of the seat and L the lift in inches; if the seat angle is 45 deg., the area becomes $\pi \times D \times 0.707\ L$. Using these values in the equation for steam flow, and including the nozzle efficiency of 92.5 per cent, the steam capacity for safety values becomes:

$E = 150 \times P \times D \times L$ for flat seats (2)

$E = 105 \times P \times D \times L$ for 45-deg. seats (3)

Different manufacturers make valves having 45-deg. seats with lifts varying from $\frac{D}{30}$ (low lift) to $\frac{D}{10}$ (high lift). One manufacturer makes a flat-seated valve with the extreme by high lift of $\frac{D}{4}$.

[1] This nozzle efficiency is slightly more conservative than used in the A.S.M.E. Boiler Code.

The capacities of high- and low-lift valves with 45-deg. seats operating at 100 lb. per sq.in. abs. are shown by curves in Fig. 2. To obtain the capacity of a valve at some other pressure P, it is only necessary to multiply the values taken from the curve by $\frac{P}{100}$. The capacity of a valve having any lift $\frac{D}{N}$ may be found by multiplying the value found from the $\frac{D}{10}$ curve by 10, or by 30 if the $\frac{D}{30}$ curve is read.

The following example is given to illustrate the co-

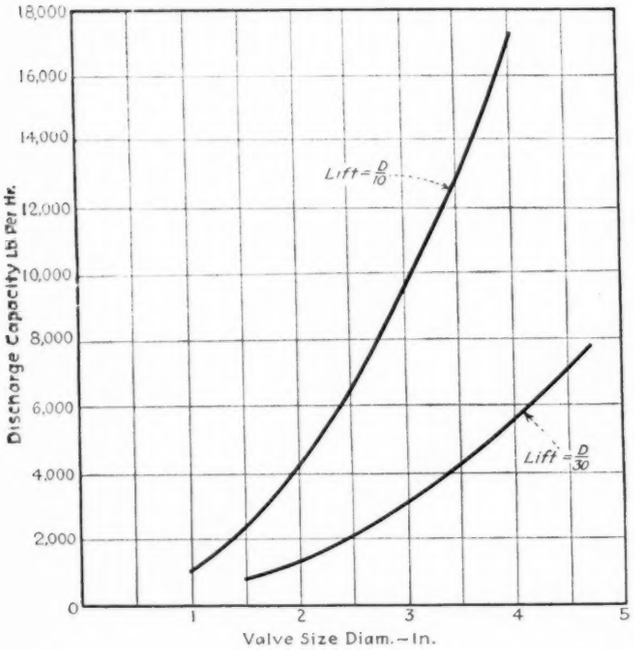

Fig. 2—Capacity curves for safety valves having 45-deg. seats calculated from equation 3

ordination of the boiler-steaming capacity and the safety-valve capacity calculations.

A boiler at the time of maximum forcing uses 4,000 lb. of bituminous coal per hour. The boiler pressure is 235 lb. gage, or 250 lb. absolute.

Fig. 1 shows that at this rate of burning coal the steaming capacity of the boiler is 45,000 lb. of steam per hour.

From Fig. 2 it is found that a 3-in. low-lift valve at 100-lb. pressure has a capacity of slightly more than 3,000 lb. per hour. At 250 lb., the capacity is $3{,}000 \times 2.5 = 7{,}500$ lb. per hour. Since the steaming capacity of the boiler is 45,000 lb., there will have to be installed $\frac{45{,}000}{7{,}500} = 6$ three-inch low-lift valves. Following the same procedure, it will be found that either two 3-in. high-lift valves or three low-lift 4½-in. valves will also relieve 45,000 lb. of steam per hour.

The total annual cost, which should include maintenance charges as well as fixed charges on the initial investment, will determine which combination of the various types and sizes of valves is the most economical. It should be noted that as the number of valves installed is increased, the cost of keeping them in repair will also increase.

How Selsyns Are Used in Transmitting Power-Plant Signals

By A. E. Bailey, Jr.*

Selsyns, or small self-synchronizing motors, are being used extensively for transmitting signals about power plants and in other places. The selsyn motor in outward appearance is similar to a three-phase induction motor. In application, at least two of these motors are used, one a sender and the other a

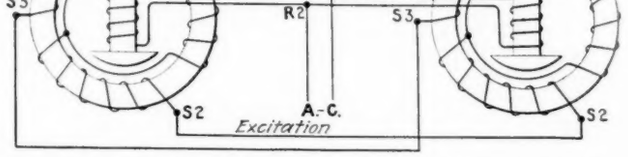

Fig. 1—Simplified diagram of signal-system connections

receiver. When properly connected, the characteristics of these devices are such that all rotors maintain a fixed relation to the stator windings. If the position of one rotor is changed, all the others will take similar positions.

A schematic diagram of a simple transmitting and a receiving unit is shown in Fig. 1. The rotors are shuttle-wound with definite poles, and the winding is

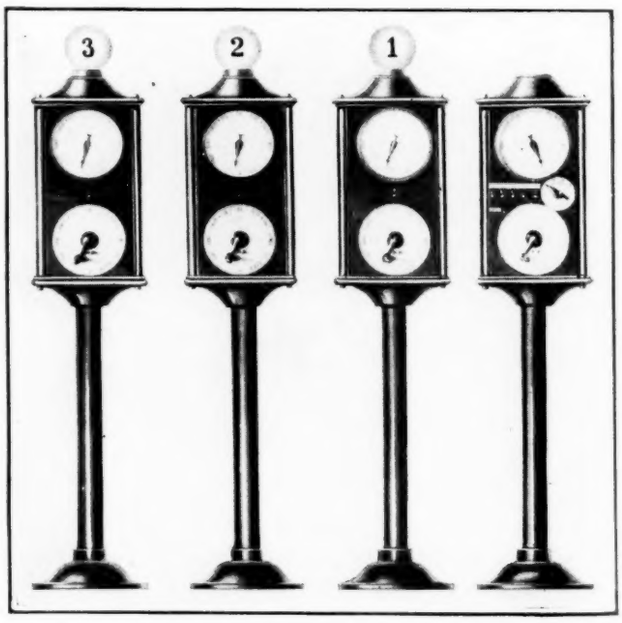

Fig. 2—Transmitting station on the right, three receiving stations on the left

connected through slip rings to a single-phase source of alternating current. The same source should be used for exciting the transmitter as is used for the receiver. If there is more than one receiver, they are all connected in parallel.

With the supply circuit closed, as in Fig. 1, an

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alternating voltage is impressed upon the rotors and as the receiver rotor is free to turn it will take up a position in correspondence with the transmitter rotor, and if the transmitter is turned the receiver will follow at the same speed and in the same direction. The reason for this synchronous operation is that the single-phase current in the rotor induces voltages in the three legs of the stator circuits. These three voltages are unequal and vary with varying positions of the rotors. If the receiver rotor is in exact correspondence with the transmitter rotor, the voltages induced in the receiver stator equal and balance those induced in the transmitter stator, so that no current will flow in the stator or secondary circuits.

If the receiver rotor is restrained from assuming the same position as that of the transmitter, the voltages induced in the transmitter and receiver stators will no longer be equal and balanced, and current will flow in the stator circuits. This current will react upon the rotors, setting up a torque which tends to bring them into agreement. As the transmitter rotor is held mechanically or manually in a definite position, the torque reacts against the force which restrains the receiver, tending to bring it into correspondence with the transmitter. A selsyn indicator always tends to seek that position where it is in synchronism with the transmitter, resisting any effort to coerce it from that position.

The applications to which a selsyn system of remote indication or control may be used to advantage are for

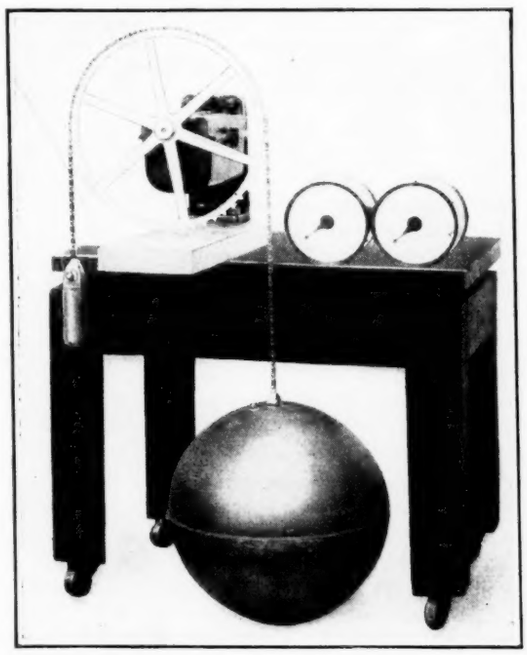


Fig. 3—Equipment for liquid-level indicator

liquid-level indicators, valve-opening indicators, station-signal boxes, gate-opening indicators, elevator indicators, brush-shifting gear for motors, rheostat-position indicators, transformer-tap indicators, supervisory-control systems, station-load indicators, and other purposes.

Fig. 2 shows a station signal transmitter and three indicators. Each indicator is located at a generator and has a repeat-back transmitter, so that acknowledgment of the signals received may be confirmed. A selector switch is mounted on the transmitter pedestal, so that the operator may select and signal to the generator in which he is interested at that time. All the apparatus is mounted on pedestals. Bells or horns are used to announce a new signal or its acknowledgment, while lights are used to indicate its destination.

Another application is that of measuring and indicating changes of water level in lakes, reservoirs, forebays

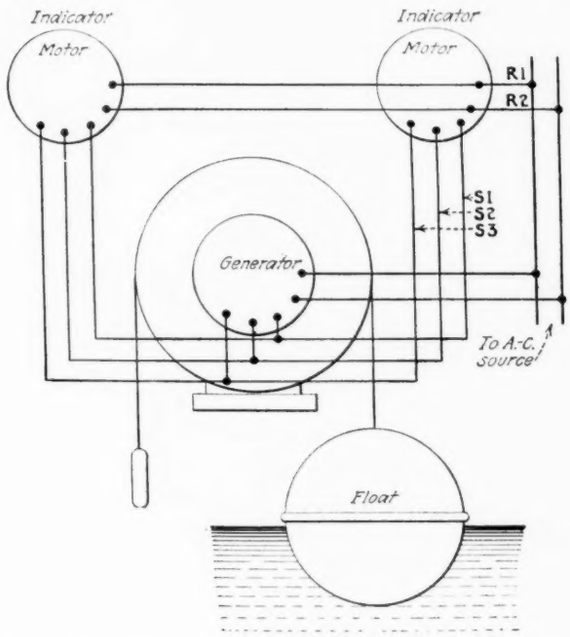


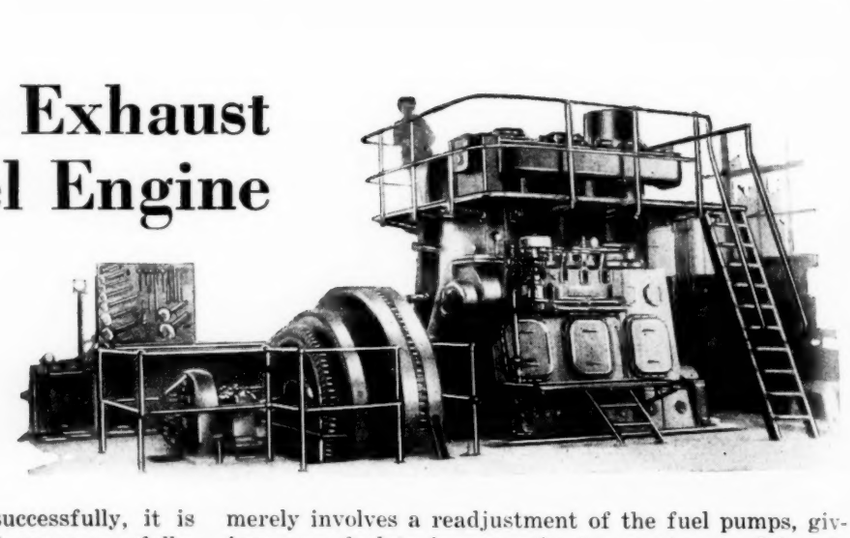
Fig. 4—Diagram of connections for liquid-level indicator

and tailraces. Fig. 3 shows the apparatus for one of these installations. The receiving element, shown at the right, is mounted on a panel in a case that conforms in appearance to a round-type instrument. The transmitter is driven by a float and countershaft through the medium of a sprocket wheel, chain and gearing. Fig. 4 shows the connections for one water-level transmitter and two indicators in parallel.

The selsyn system is useful in automatically controlling mechanisms from a remote position. One application of this kind is for the remote or automatic control of the position of the brushes on variable-speed commutator-type polyphase motors. The impulses received by the selsyns, of which there are two in this case, selectively connected to the transmitter, are transmitted through the contact arm or their rotor shafts. The closing of these contacts starts a small motor which rotates, through gearing, the brushes on the main motor. At the same time that the small servo-motor drives the brushes, it rotates the contacts through which the selsyn motor contact arm controls its motion. Therefore, when the motor has rotated the brushes as far as required, the contact between selsyn contact arm and the contacts driven by the servo-motor will be broken and the servo-motor will stop.

During the time that the servo-motor is driving, it rotates a drum controller which, through contactors, changes the connections to the main motor, thereby regulating its speed. One selsyn receiver is connected to the transmitter for star or starting connections of the motor, while the other is connected for delta, or high-speed motor connections.

Watch the Exhaust of a Diesel Engine



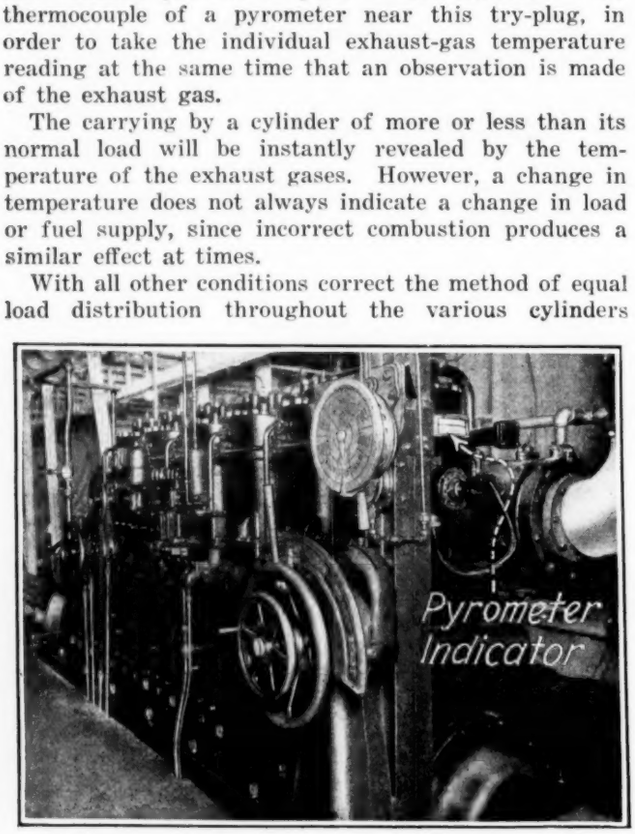
By A. B. NEWELL

TO OPERATE the oil engine successfully, it is necessary to watch the exhaust gases carefully, and since the escape to the atmosphere is through a common exhaust pipe, all the gases may be contaminated by the foul exhaust of a single cylinder of the group. Therefore, what is apparent at the end of the pipe may not be characteristic of conditions existing in all the cylinders, and it is necessary to observe the gases as they leave each cylinder.

In order to make this procedure possible, most engine builders have provided a try-plug which communicates with the exhaust-gas passage directly outside of the exhaust valve on four-stroke-cycle engines, and with the exhaust ports on two-stroke-cycle engines. It is also common practice to place a thermometer or the thermocouple of a pyrometer near this try-plug, in order to take the individual exhaust-gas temperature reading at the same time that an observation is made of the exhaust gas.

The carrying by a cylinder of more or less than its normal load will be instantly revealed by the temperature of the exhaust gases. However, a change in temperature does not always indicate a change in load or fuel supply, since incorrect combustion produces a similar effect at times.

With all other conditions correct the method of equal load distribution throughout the various cylinders merely involves a readjustment of the fuel pumps, giving more fuel to increase the temperature and less to decrease it until the temperatures of the gases leaving the various cylinders are uniform, whereupon it may be assumed that the load is equally distributed.



Two-stroke-cycle Diesel has an exhaust pyrometer as a standard equipment

A constant falling off in temperature of one or more cylinders with a corresponding increase in temperature of the others would indicate that the fuel pumps of those with the lowering temperature were becoming out of order and pumping less fuel, while the governor, in functioning to maintain normal speed, would cause more fuel to be supplied to the others. Since the work loss of one cylinder may be picked up by several others, it is apparent that while the lowering temperature of the troublesome cylinder may be quite pronounced, the increase in the others may be so small as to be of apparently no consequence unless the engine is working under heavy load. The fact that the other cylinders will carry the load does not excuse neglect of the faulty one, and where the falling off is constant, readjustment of the fuel pump becomes futile and a complete overhauling, particularly valve grinding, is essential.

A Sense of the Job

These are direct manifestations of what is taking place; they are the obvious, the commonplace, the regular run of changes. The capable engineer develops a sense of his job that is not so easily described. He sees, smells or hears something that is not right or by the same means determines when all is well.

As an aid the thermometer holds first place, but it will not tell when the engine is smoking or making a peculiar noise. There are different kinds of smoke. A light blue haze indicates too much lubricating oil, black smoke too much fuel and not enough air or poor atomization of the fuel, while light gray smoke may indicate a slight overload, late combustion or afterburning.

If the try-plugs are so arranged that the engineer can look directly into the exhaust pipe, he is able to observe other manifestations with the smoke. There may be a red flame with black smoke or a bright red one with grey smoke. When such a flame passes over the exhaust valves, it will burn them. Under ordinary conditions combustion will end before the valve opens and hot gases only will pass over it. If such a flame does not appear with the smoke, it is a fair indication that either the engine is not getting enough air, possibly as

the result of clogged breather pipes, or there is loss of compression through leaking valves and rings. Under either condition there is not enough oxygen to burn the fuel during the working stroke, and of course, no air is left to burn it after the exhaust period begins.

It is safe to assume that the governor will distribute the increased fuel supply evenly over a number of cylinders and that no pump of the group will begin to pump more fuel than usual unless it has been readjusted to make it do so. Therefore, when a number of cylinders show smoke, the trouble probably lies in the one that is burning clear, for the governor has probably thrown the load on the good cylinders because it was impossible to throw an overload on a cylinder being supplied by a defective fuel pump; as a result the overloaded cylinders smoke.

Fuel-Valve Adjustment as It Affects the Exhaust

If the engineer knows definitely that the fuel pumps are in good condition and that the engine is getting enough air, he should look to his fuel-valve adjustment to locate the cause of smoke. The adjusting screws on the fuel-valve cam may have worked loose and permitted the nose of the cam to shift back, in which case the defective cylinder will show a smoky exhaust. Sometimes a similar manifestation is the result of the roller clearance increasing through the locking nuts on the adjusting screws coming loose and the screws backing up. On many engines this clearance may be re-established without stopping the engine, but it is never possible to reset a fuel valve cam while the engine is running.

To reset the clearance without stopping the engine, it is a good plan to have the try-plug open in the exhaust and screw down on the adjusting nuts or screw until the exhaust clears. If it does not clear up, the trouble probably lies in a dirty atomizer. By reducing the clearance, the time of fuel valve opening is set ahead and the duration of fuel injection increased somewhat. The maximum pressure will be raised abnormally if this adjustment is carried too far, but if it happens that the atomizer is dirty, the dirt may so retard the injection of fuel as to prevent an excessively high pressure, and the increase in duration of injection will merely tend to rectify the restriction. After such an adjustment has been made, it is best to use an indicator to ascertain the maximum pressure developed, bearing in mind that to clear up the exhaust in this way is merely choosing the lesser of two evils. It is better to have the engine slightly out of adjustment than to have it smoking badly, and it is sometimes possible for such a timing adjustment to enable the engine to carry on until such a time as a shutdown can be made without causing inconvenience.

Other Ways of Clearing Up the Exhaust

Sometimes the exhaust can be cleared up by increasing the injection-air pressure, by switching over to kerosene and burning that for half an hour or by cutting out the fuel to the defective cylinder and letting air only pass through the atomizer.

With the solid-injection method of fuel introduction it is not possible to rectify a faulty condition of atomization or combustion while the engine runs, but when fractional load is carried it may be possible to readjust the fuel pumps to reduce the load on the cylinder that shows smoke without overloading the other cylinders.

When the smoke is very black, there is seldom much hope of clearing it up while the engine runs, and it is best to shut down and locate the trouble. If it is necessary to keep the engine in service, the supply of cylinder lubricant should be increased considerably in order to keep the accumulation of soot on the cylinder walls and piston in a fluid state. This may prevent a piston seizure, which could occur as the result of such soot drying up when only a normal supply of cylinder lubricant is used. However, to increase the cylinder-oil supply invites carbonized rings, and the only advantage in so doing lies in the fact that carbonization as the result of over-lubrication is comparatively slow, while piston seizure as the result of insufficient lubrication is fast and very destructive in its action.

Other Conditions Detected by Observation of Exhaust Gases

With practice in observing the exhaust gases the engineer can learn to detect other conditions that need attention. Sometimes sparks appear but no smoke. They are generally small particles of incandescent carbon that have started to burn on the cylinder wall and have broken loose to come racing along the exhaust pipe.

On the two-stroke-cycle engine the exhaust gases sometimes appear to be oily. This is because the surplus lubricant escapes at the exhaust ports where the heat is not so intense as to burn it. Although it will appear as oil at the try-plug, it may pass into the atmosphere so finely atomized as to be invisible or it may burn in the exhaust pipe with the surplus air that is forced through the engine with the scavenging pump. Sometimes the exhaust gases are hotter twenty feet from the engine than they are when they leave the cylinder; this is the result of combustion in the exhaust pipe. This also tends to clear up smoke that may be apparent at the try-plug but not apparent at the end of the exhaust pipe.

It is not always best to attempt to clear up all the sparks or to eliminate the oily condition of the exhaust gases, as experience indicates that sometimes more oil is required than what is theoretically right.

The Slide Valve Found Most Often with shaft governors is the balanced double-ported type. In this valve steam is admitted to the steam port through the opening in the valve and at the edge of the valve. The exhaust steam in the usual design flows by the exhaust edge of the valve. Since the eccentric is fastened to the flywheel, which in turn is keyed to the shaft, the only valve adjustment ordinarily possible is equalizing the lead by adjustment of the valve rod. The first step is to block the governor so the weight arm is in the position it assumes for full-load conditions. A block of wood may be placed between the governor stop on the flywheel and the weight arm. The engine should be turned to crank dead center and the lead measured. Turning the engine on over in the running direction to head-end dead center, the head-end lead is measured. If the two are not equal, half the error is taken up by adjusting the rod length. The lead on both ends is checked again. If the lead given the valve is more than is advisable in cases where the steam pressure has been raised above the designed pressure, the flywheel and eccentric may be shifted by cutting a new keyway.

Transformers Connected Open-Delta on a Three-Phase Four-Wire System

On three-wire three-phase systems it is common practice to use two transformers connected in open-delta. When such a connection is made on a four-wire system, special problems are involved that are answered in this article

By J. B. GIBBS
Transformer Engineer, Westinghouse Electric & Manufacturing Company

WITH the rapidly increasing demand for power comes the problem of how to increase the supply. This means not only an increased generating capacity, but also an increased line capacity in the transmission and distribution systems; and any plan that contributes to this end is valuable.

The easiest way to increase line capacity is to raise the voltage. If the increase is such that existing line insulation and present transformers can be used, this method is also economical. Both these things are true of 2,300-volt distribution systems, both three-phase and two-phase, and many operating companies are converting such systems into 4-wire three-phase 4,000-volt systems. If the system was formerly two-phase, the four wires are already in place on the poles, and three of them are used as phase wires, with the fourth as a neutral. In this case no additional wire will have to be strung, but the motors on the system will have to be changed from two-phase to three-phase, or else transformers will have to be used with taps for three-phase to two-phase transformation.

If the system was formerly three-phase, it will be necessary to string an additional wire for the neutral, but no change will be needed in the motors or transformers. The transformers will merely be connected in star from the neutral to the three lines instead of in delta from line to line, since the voltage from neutral to line in a 4,000-volt system is 2,300 volts. The transformer secondaries will be connected in delta as before. Fig. 1 shows a three-phase 2,300-volt line with three transformers connected in delta. Fig. 2 shows a two-phase line and transformer bank, and Fig. 3 shows a 4,000 volt 4-wire three-phase line with three transformers connected in star on the high-voltage side and in delta on the low-voltage side.

If a single-phase load is to be supplied from the line shown in Fig. 3, a standard 2,300-volt transformer is connected from one of the lines to the neutral wire. Other single-phase loads may be similarly connected to the other phases. An attempt should be made to balance such single-phase loads as well as possible so that the current in the neutral wire shall be a minimum.

If small three-phase loads are to be carried, it is convenient to use two transformers instead of the three shown in Fig. 3. This arrangement makes a neater and a cheaper installation on the pole. The connection, which is shown in Fig. 4, uses two standard 2,300-volt transformers. One is connected from neutral to line *B* and the other from neutral to line *C*. The secondaries are connected as shown, one secondary being reversed with respect to its primary, so that a true open-delta is formed. This connection has the same disadvantages as the usual open-delta. It requires transformer capacity 15 per cent greater than the load to be carried, and the voltage drop in the transformers is not exactly balanced. Besides this, the connection draws current through the neutral wire. This may be serious, under certain circumstances, but usually it is not objectionable.

For example, suppose that a load of 100 kva. at 80 per cent power factor is to be supplied from a three-phase 4-wire 60-cycle distribution line. The secondary line consists of three No. 4 wires, spaced on the crossarm as shown in Fig. 5. The distance from the transformer to the load is 200 ft. Assume also that the load is three separate impedances and not a three-phase motor, which would have a tendency to balance the

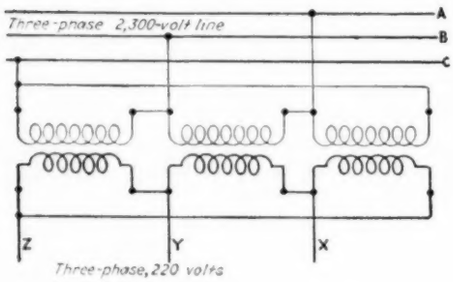


Fig. 1—Three-wire three-phase transformer connection

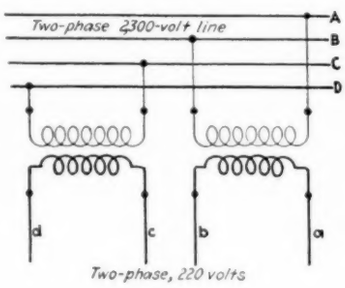


Fig. 2—Two-phase transformer connection

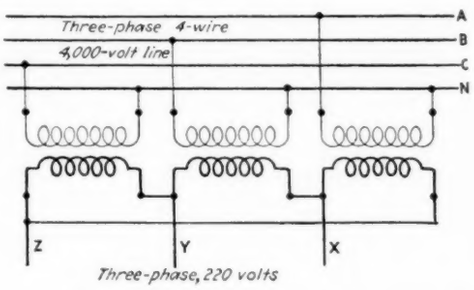


Fig. 3—Four-wire two-phase transformer connection

voltages. Then, if the voltage at the transformer primaries is 2,300 and balanced, the voltages at the load will be 424, 438 and 432, when the normal secondary voltage at the transformer is 460. The three secondary currents will be 115, 116.5 and 119 amperes. This unbalance is small, and if the load were a three-phase motor, the unbalance would be still smaller.

If the primary current were drawn for a long distance through the neutral wires, the unbalance might be considerably increased, but the example given is more like an actual operating condition.

It should be noted that the power supplied with this connection is drawn through two lines and the neutral without imposing any load on the third line. The connection causes an unbalanced loading of the generator and of the system and should, therefore, be used only for small amounts of power. In addition to this, if much current is drawn through the neutral for any considerable distance, the voltage at the end of the line will be unbalanced more than is indicated by the figures above, and unsatisfactory operation will probably result. This connection is sometimes useful for small amounts of power or for emergencies, but it should not be regarded as a standard connection.

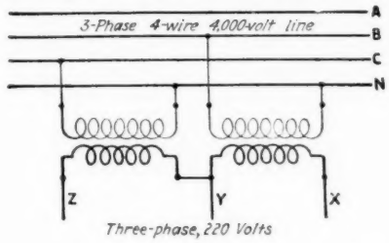


Fig. 4—Open-delta connection on four-wire three-phase line

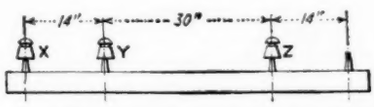


Fig. 5—Conductor spacing on cross-arm

Furnace Water Screens and Walls

As a result of a wider application of furnace water screens and walls the Prime Movers Committee has assembled considerable experience in their design and operation.

Heat-absorption rates equivalent to over 2,000 per cent of rating based on screen surface have been reported. At this high rate of heat transfer, elimination of scale and ample water circulation, so as to limit the proportion of steam in the tubes, are necessary if bags and blisters are to be avoided.

To improve the water circulation special methods have been employed, such as installing bell-mouth castings to reduce the hydraulic resistance at the entrance to the screen tubes. Another method successfully used is the separation of the water-screen circulation system from the main boiler system and providing separate feed connections to it.

To eliminate the possibility of scale forming in the tubes, frequent blowdown separately from the boiler water leg is required. Blowdowns should be made when the boiler is down or at low ratings in order to avoid disturbing water-screen circulation.

What Do You Know?

IT'S about time that a "Who's Who in Engineering" was compiled. Engineers have always been unduly modest, and few are those whose names are associated with their achievements. Just now the world is agog with the names of Lindbergh and Chamberlin, yet the success of both ventures depended on the designers of the engines and planes used. Who knows the engineer whose hopes were built into the Wright Whirlwind Engine? But are engineers unknown to fame? The questions below cover names and data on important inventions; have the readers of *Power* forgotten the answers? Try to see how many you miss. If you answer 50 per cent, you can be classed as a well-read engineer. The answers may be found on page 957.

Ques. 1—Where was the first locomotive operated in the United States, when and by whom?

Ques. 2—Who built the first steam-operated boat in the United States?

Ques. 3—Where, in America, was the first steam pumping engine placed in service?

Ques. 4—Who invented the alternating-current transformer?

Ques. 5—Where was the first electric central station located?

Ques. 6—Who built the first engine using a heavy fuel oil?

Ques. 7—Who built the first ice plant in this country?

Ques. 8—Who built the first water-tube boiler?

Ques. 9—What central station was the first to install a steam turbine in the United States?

Ques. 10—Who was the first president of the American Society of Mechanical Engineers?

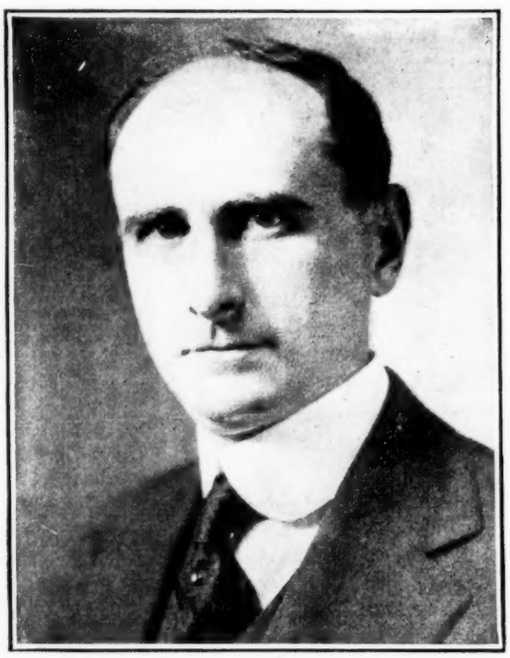
Corrosion in boiler drums may be effectively retarded by the use of protective coatings. It is necessary before applying such coatings that the boiler drum be thoroughly clean. This cleaning may be accomplished by using wire brushes and then hand scraping to remove the soft scale. If any hard scale remains, it can be chipped off with a small air hammer. When applied to surfaces not thoroughly clean, the coating will not adhere for any length of time. Such coatings have also been applied to economizers, but no definite conclusions have as yet been formed.

Humanizing Technical Education

Purdue University Takes Lead in Development of System Which Benefits Students and Employers Through Rating of Students' Personality as Well as Scholarship

By R. C. WOODWORTH

A SINCERE attempt to develop the personality and character of technical students as well as impart engineering training is being made in the schools of engineering at Purdue University, Lafayette, Indiana. Technical education is often accompanied by the accusation that it overlooks the human element, but Purdue's attempt to "humanize engineering education," after six years of development, is meeting with considerable success and is attracting widespread interest in the outside engineering world as well as within college walls, especially from employers who find the system invaluable as a guide in selecting graduates for employment. Prof. A. A. Potter, dean of the engineering schools at Purdue, is known as the father of the movement. A former president of the Society for the Promotion of Engineering Education and a recognized leader in the engineering education world Professor Potter has seen his dream develop to the point where other institutions of higher education have recognized its value and set up similar systems.



A. A. Potter

Dean of engineering schools at Purdue University, who started the movement to develop personality of engineering students.

The movement, when first started, resulted in the organization of a personnel bureau at Purdue, which at the present time is headed by J. E. Walters. The bureau in reality makes a character analysis of each student, keeping a complete record of the mental, physical, religious and social development of the students during their university careers. It works on the theory that studies and work develop the student's mind, the athletic department develops his body, the church betters his character and the personnel system should improve his personality.

The system gets under way with the registration of the freshmen as soon as they arrive. Each entrant is required to fill out a series of blanks giving a record of his life and past experience, along with information concerning his family. In the latter part of his freshman year the student fills out a reference blank containing the names of fifteen people who are qualified to rate him on the characteristics of his personality. It is provided that five of the references named be teachers that the student has come in contact with at the university, five be students, and five be men who have no actual contact with the university.

Personality rating blanks are then sent to the fifteen references, who are asked to rate the student's personality through the medium of the questions printed on the blank. The blank itself perhaps explains the system better than any description. That used at Purdue has the following questions:

1. ADDRESS AND MANNER: (Does he leave a good impression? Does he talk well? Is he popular? Has he a good bearing?)
2. ATTITUDE: (Is he rational, agreeable to reason in his views? Interested in his work? Optimistic? Self-controlled?)
3. CHARACTER: (Is he reliable? Dependable? Absolutely honest? Responsible? Clean? Just? Courageous?)
4. CO-OPERATIVE ABILITY: (Can he work with others? Is he accommodating? Loyal? Willing to learn? Tolerant? Tactful? Is he a good mixer?)
5. DISPOSITION: (Is he cheerful? Courteous? Congenial? Enthusiastic and not conceited?)
6. INDUSTRY: (Is he a hard worker? Has he perseverance? Is he persistent?)
7. INITIATIVE: (Is he a self-starter? Does he recognize, start and develop opportunities to a successful conclusion? Is he original?)
8. JUDGMENT: (Has he common sense? Observing and reasoning power? Foresight? Resourcefulness? Does he know values and the relations of things? Is he practical?)
9. LEADERSHIP: (Does he understand men and can he command their respect? Has he executive ability? Does he precede and direct men?)
10. NATIVE CAPACITY: (Is he naturally accurate, systematic, bright, alert? Has he an inherent knowledge of facts and data? Can he concentrate? Does he learn readily? Has he a natural aptitude for work?)

The rating scale ranges from one to ten. There are five general classifications—poor, low, average, high and highest. Poor ranges from one to two; low from three to four; average, from five to six; high, seven to eight; highest, nine to ten.

References are advised in filling out the blanks to make the ratings in comparison with men of similar

age, educational preparation and environment. As soon as the fifteen ratings are received in the personnel office, they are averaged so that the prejudices of one or two will not greatly affect the total average. The ratings are then compiled and recorded on the student's personnel record, along with the scholastic record of the student.

But the activity of the personnel bureau does not stop there. If the general average of the ratings on all the characteristics is low, the student is called into conference by the personnel director or a member of the staff and asked why he has impressed fifteen people as being low in particular characteristics. The troubles of the student are discussed in detail and methods of improvement are then suggested.

This same general procedure is repeated in the third, or junior, year. As soon as the data from the references supplied in the junior year reach the personnel office, they are compiled and a careful study made of the ratings in comparison with the ratings of the freshman year. If the characteristics are not improved after the junior rating, the student is called in for another conference. Suggestions for improvement are continually made to students with low characteristics, and in the senior year another chance is given for improvement.

In addition to the rating of personality, the personnel office, through its contact with the students, naturally serves as an agency where students are made to feel that they may go freely for advice. No matter what their problems may be, the personnel director makes an effort to give assistance, and if he cannot, advises the students where to go for the information or help.

One of the biggest opportunities of the personnel bureau comes in the senior year when the time for consideration of employment arrives. With the records of three years supplementing personal conferences in many cases, the personnel director is able to give expert advice on the type of position that a student will be fitted for. The system works to the mutual advantage of the student and the employer, for the employer may get invaluable information concerning the positions for which students are fitted, and the student may get advice concerning the best type of position to accept.

Nor does the interest of the personnel bureau cease with the graduation of the student. After sufficient time has elapsed to allow employers to gage the caliber of work that is being done by a former student, a "Progress Blank" (another form of personality rating blank) is sent to the employer. If the report is unsatisfactory, this information is transmitted to the alumnus together with suggestions that may help in eliminating deficiencies mentioned by his employer. Letters are sent to the employer asking his co-operation in giving the graduate the best possible opportunity and encouragement to improve. Sometimes a visit is paid to the employing company by a representative of the personnel bureau in an effort to iron out difficulties.

Proof that industry approves of the personnel system is furnished in the fact that the initial funds to start the bureau were donated by the Indiana Manufacturers' Association and that this organization has continued to bear a substantial proportion of the current expenses from year to year. Hundreds of letters have been received from industry lauding the system and from students and graduates who have been benefited by its workings.

Answers To "What Do You Know?"*

Ans. 1—The first locomotive to be used in America was built by Foster, Rastrick & Co., London, England, and was purchased by Horatio Allen for use on the Delaware & Hudson Canal Co.'s road from Carbondale to Honesdale, Pa. It was placed in service in 1829.

Ans. 2—Oliver Evans in 1809 completed a boat at Philadelphia having its paddle wheels driven by a steam engine.

Ans. 3—Josiah Hornblower, of England, erected a pumping engine at the Schuyler Copper Mine in New Jersey in 1755.

Ans. 4—Goulard and Gibbs, of England, held the first patent, while William Stanley, of America, produced a transformer about the same time, between 1890 and 1892.

Ans. 5—The first central electric-light station was installed at Appleton City, Wis. This was driven by a waterwheel.

Ans. 6—Brayton's constant-pressure engine developed between 1870 and 1875 is probably the first real heavy-oil engine.

Ans. 7—Dr. Gorrie built a dense-air ice machine in Florida in 1850.

Ans. 8—The earliest water-tube boiler was built by Barlow some time before 1793, while John Stevens, of Hoboken, built one in 1804.

Ans. 9—The first steam turbine in the United States was installed in the plant of the Hartford Electric Light Co.

Ans. 10—R. H. Thurston was the first A.S.M.E. president, holding office from 1880 to 1882. He died in 1905 and was a noted teacher, author and engineer.

The Editor Corrects Himself

Editors are, after all, mortal and occasionally have a fall from grace. Fortunately, one at times discovers one's sin before the public is alive to the transgression. This befell the "What Do You Know?" editor when in the June 7 issue he stated that the head sheets of a tubular boiler could theoretically be one-half the thickness of the shell.

This would be true only if the head were dished with a radius equal to the radius of the boiler shell. In this case the total pressure on the head would be $\pi R^2 P$ and the metal resisting this pressure along the seam would be $2\pi Rt$, where R is the radius of the spherical head and the radius of the boiler, t the thickness of metal, all in inches, and P the working pressure in pounds per square inch. The unit stress would then be

$$\frac{\pi R^2 P}{2\pi Rt}, \text{ or } \frac{RP}{2t},$$

In case of the shell the pressure exerted on a unit length of the shell would be $2RP$ which is resisted by two thicknesses of metal or the unit stress would be $\frac{2RP}{2t_1} = \frac{RP}{t_1}$. If the unit stress be the same as in case of the head, we have $\frac{RP}{t_1} = \frac{RP}{2t}$, or the head plate need be but one-half the thickness of the girth plates for a spherical head. The A.S.M.E. Boiler Code states that $t = \frac{5.5PL}{2T} + \frac{1}{8}$ where L is the radius to which the concave head is pressed. In a tubular boiler the head is supported by the tubes and stays, and the thickness is determined by the efficiency of the segment between the tubes.

*The questions will be found on page 955.

Steam Jet Stops Smoke

By H. K. Kugel*

IN A large city the smoke from steam shovels and locomotive cranes is extremely objectionable, as their stacks are low and the vertical boilers which they use are particularly given to the emission of dense smoke. A great many owners have found it necessary to use coke or smokeless coal, such as Pocahontas or New River, and even oil, in an effort to secure smokeless operation. The use of gasoline-engine-driven equipment has been furthered by this failing of the steam-driven machine.

The Smoke Department of Cleveland has found that the use of steam jets will overcome this smoke nuisance, even when using the ordinary high-volatile bituminous coal, such as is mined in Ohio. One company which operates sixteen shovels and cranes, has made a large saving by changing from Pocahontas to Ohio coal, after the installation of the jets. Also the railroads use them extensively on their locomotives in "smoke districts" and designate them as "induction tubes," which seems to describe them better than the term "steam jets."

These jets act as injectors to draw air into the furnace and mix it with the gases of combustion, thus furnishing excess air during coaling periods. The two pictures shown will give an idea of just what can be accomplished. In Fig. 1 the fireman had just fired four shovelfuls of coal and the jets were not turned on. After allowing this smoke to continue for about 45 seconds, the jets were turned on and the smoke cleared up almost instantly, as shown in Fig. 2. In fact, it cleared up so rapidly that the stack was clear before the last smoke was more than 15 ft. from the stack. These pictures were taken at the Collinwood yards of the New York Central Railroad, where three cranes are in use, all equipped with steam jets. One of these jets can be seen on the back of the boiler at *S*, Fig. 1.

*Deputy Smoke Commissioner, Cleveland, Ohio.

Fig. 3 shows how the jets are applied to any vertical boiler. For all boilers except very large ones four jets are generally sufficient. The method of supporting the steam pipe around the boiler varies according to the ingenuity of the mechanic who does the work. A great many of those in Cleveland have been held in place by means of brackets welded to the boiler itself. It is very necessary to have a drain valve or a trap in the steam line to remove the condensation, so that when the jets are turned on, the fire will not be dampened from the water that has been lying in the pipe. It is also better to install a quick-opening valve for operating the jets. The induction tubes themselves are merely 2-in. pipes that are rolled into the water leg of the boiler. A $\frac{1}{8}$-in. orifice is generally used for the jet, and the best results are obtained when this is placed about one inch away from the boiler shell. However, owing to the noise which they make, the operators often put them into the tube itself. The accompanying small loss in efficiency of the jet is more than compensated for by the elimination of the noise.

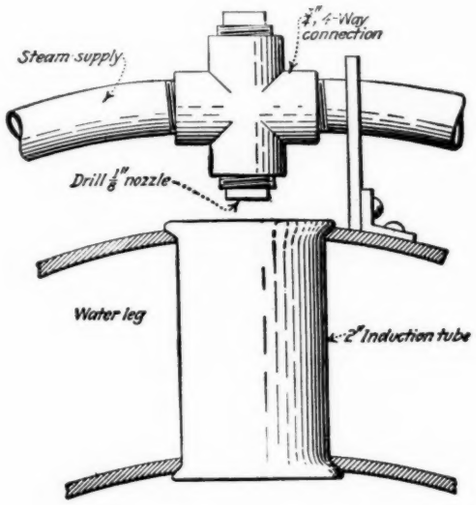


Fig. 3—Method of installing steam jet on vertical fire-tube boiler

With any device of this kind the main difficulty is in getting the operator to use it regularly. When they fail to use the jets, good results can be obtained by giving the crew a few days lay-off, which will generally fix the matter in their minds for some time to come.

It might be added that similar results have been obtained with the same type of boilers when installed in stationary plants.

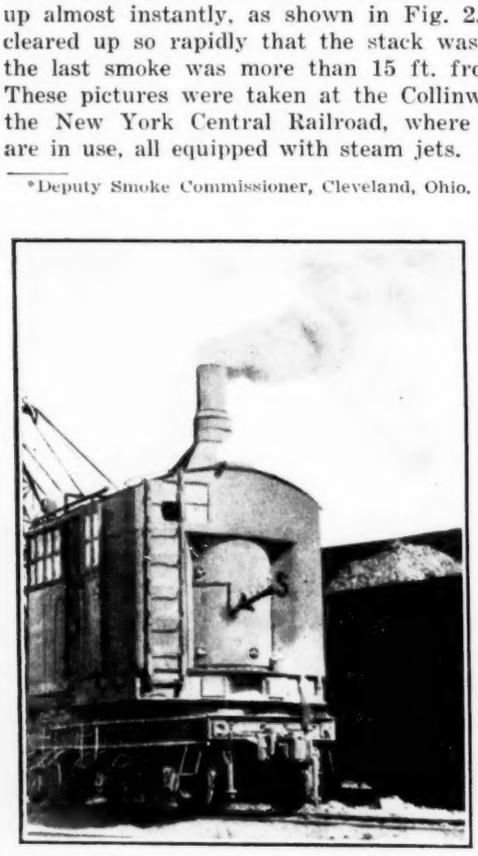


Fig. 1—Smoke caused when boiler is fired with volatile bituminous coal

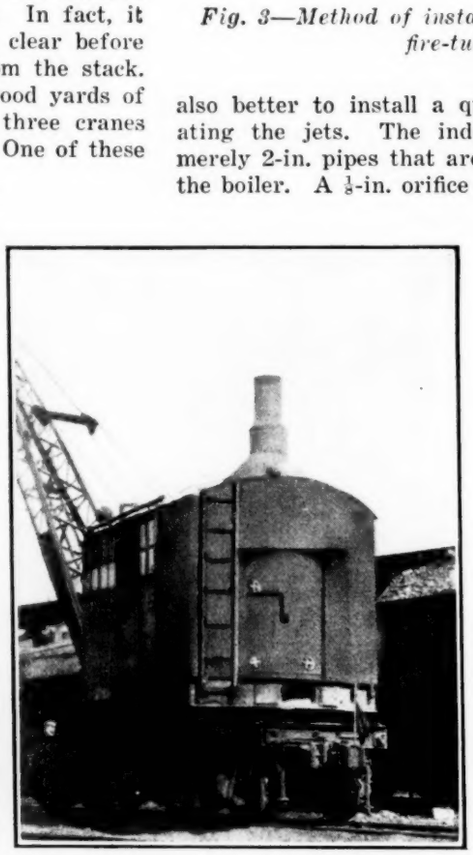


Fig. 2—The smoke seen in Fig. 1 was eliminated by operating steam jets

Do Your Heating-Plant Maintenance Now

ARE you doing the maintenance work on your heating system that was put off during the high load period of the winter months? If not, now is the time to get busy, while there is little or no load and all the equipment is available.

The boilers that have been working since last fall should be thoroughly inspected and cleaned inside and out. Possibly the grates or stokers need minor repairs. Now is an excellent opportunity to renew that packing on the feed pump that leaked all winter. And so a hundred and one maintenance jobs might be named that can best be repaired when the equipment is dead.

A little hard work now will result in a better job being done and will save a good deal of sweating later, when the heating season starts and all equipment is in demand. In addition it insures starting the plant in the fall without delay and a saving in operating costs because of the improved condition of the equipment.

Industrial Plant Leadership in Europe

EUROPE is going up faster than America, or perhaps more of it is going up. Steam pressures have jumped to 1,200, 1,500 and even to 3,200 pounds. Temperatures have gone as high as 840 degrees Fahrenheit in actual operation. Perhaps the most striking feature of the European situation is that high pressure and temperature seem to be primarily a plant development that has not been initiated in the central station.

It is realized both here and there that any power demand may be met by expanding process and heating steam from a properly chosen pressure above the process pressure, provided there is a reasonable balance between heat and power needs. In Europe this realization is materializing in industrial plants faster than it is in the United States. Oddly enough, it has not affected European central station design as conspicuously as it has in America, although the municipal plant at Bradford, England, is installing a 2,500-kilowatt unit to steam at 800 pounds per square inch and exhaust into the present steam header.

Both central stations and industrial plants have much to gain from the wise use of high-pressure steam, but by and large the industrial plant probably has better chances for savings, if it has any good reason for using high-pressure equipment at all.

An interesting aspect of the entire development, noted by engineers on both sides of the water, is that the high-pressure portion of a plant does not appear to be as costly as it is usual to assume. In some instances it appears that the high-pressure equipment has cost no more, per unit of capacity, than low-pressure units of like characteristics.

The American industrialist should keep his eyes open to the possibilities in his own plant for the generation of power and heat at a low combined cost. And perhaps the day will come when the electric utilities will more generally do what the more progressive companies do today—tie in with well-operated industrial plants for the interchange of power at mutually profitable rates. This happy end can come only through the improvement of the industrial plant to a point where, by sheer quality, it can command the respect of the central-station engineer, whose standards are high.

Base Results on Net Output

PLANT costs should be based on plant output; that is, upon everything that really does go out of the plant. Similar accounting should be carried down to the boiler room and engine room separately, and perhaps even to individual units.

The efficiency of a boiler can be improved by the addition of economizers and air heaters, but these increase the draft loss and call for more power to drive induced-draft fans, which perhaps were not used at all before the addition of the heat-saving equipment. As a result, there are really two efficiencies for the boiler—the gross and the net. The gross figure charges the boiler with the heating value of the fuel burned and credits it with the heat absorbed by water and steam. But what about the power supplied? Should that not be charged also? Did it not cost money—the same kind of money that was paid for the fuel? Most assuredly, some account must be taken of everything supplied to the boiler. When the fan—and of course the same remarks apply to other boiler auxiliaries—is driven by a steam engine, it is easy to deduct the steam it uses from the boiler output and to figure the efficiency on the basis of the net steam delivered. However, it is perhaps more common to drive auxiliaries by electric motors, and then the kilowatt-hours used must be charged against the boiler. This energy must be combined with the heating value of the fuel to secure the total charge. Some do this by establishing a heat equivalent of motor input—B.t.u. per kw.-hr.—either by test or by guess. Others prefer to reduce both heat and power to their money cost and compare the boiler results in terms of cents per thousand pounds of steam or, better, cents per million B.t.u. in steam.

Shall maintenance be included? If high thermal efficiency of low fuel-and-power cost is attained for the steam produced at the expense of driving the furnace to the point where the firebrick walls suffer heavily, should not the increased maintenance be charged against the process? And if this be done, what shall be the period to be covered? A week or a month is inadequate. Perhaps a year would be long enough. Perhaps not.

The same sort of discussion would apply to the turbine or engine equipment of a plant.

Tight Dampers

WHEN the relative merits of powdered coal and stokers are discussed in an engineering meeting, proponents of the former usually advance the point of saving in fuel during banking periods. This is answered by the stoker men with the assertion that the only loss in either case is through radiation from the walls of the setting; that this loss has to be made up after the burners are relighted, in the case of powdered coal, whereas with stokers the heat is replenished continuously. Hence, after all, there is no difference.

This reasoning is logical, but one factor is often overlooked—that of the damper. With stokers it is impracticable to seal the damper completely, lest the gas generated fill the boiler room or produce a dangerous condition in the furnace. Therefore some heat must continue to go up the stack. On the other hand, with powdered coal it is not only possible but desirable to close the damper completely and thus prevent loss up the stack during banking periods. Some operators have recognized this and are insisting that they be provided with tight dampers.

The foregoing is mentioned not with a view to making comparisons between stokers and powdered coal, for each has certain advantages which may or may not be decisive, according to local conditions, but rather to remind operators of powdered-coal plants that they cannot afford to neglect their dampers.

Reheaters and Reheating

REHEATING has been adopted in several large power plants, the earlier installations employing certain boilers of special design having a large area of reheating surface. The steam at some intermediate stage in its expansion is taken from the turbine to these reheating coils in the boiler, where its temperature is raised by the flue gas substantially to that of the high-pressure steam initially entering the turbine. These pipes are large and expensive, since ample provision must be made for expansion. A certain unavoidable pressure drop occurs in this reheating which offsets to some extent the gain from the reheating. However, the reheating by flue gases has proved an economical procedure as indicated by the satisfactory operating results reported at Philo and Columbia power stations.

The object of reheating to temperatures of seven hundred degrees Fahrenheit or more is to keep the expansion of the steam in the low-pressure portion of the turbine almost wholly in a superheated state. Losses due to moisture in the low-pressure blades are overcome, and the operating efficiency of the cycle is increased.

In some recent installations, one of which will shortly go into service, reheating will be done at the turbine in a reheater using high-pressure steam from the main steam line. This will provide a more compact equipment with no long runs of piping and probably will also decrease the pressure drop below that in the case of reheating boilers. On the other hand the steam cannot be reheated above the saturation temperature of the high-pressure steam which, with pressures of six hundred pounds, limits reheat to about four hundred ninety degrees. Obviously, the steam expanding in the low-pressure portion of the turbine will be wetter than when reheated in reheating boilers to seven hundred degrees; hence the efficiency of the turbine as a whole will decrease when compared with flue-gas reheating.

While from a theoretical point of view the use of live-steam reheaters does not appear to be as economical for the plant as a whole as the use of reheating boilers, the lower installation cost, simplification of station layout, supersaturation effect of the first small percentage of moisture and other practical considerations are likely to modify this conclusion. The influences of these factors are not at all certain and engineers will welcome further enlightenment. If steam reheating is as successful as its enthusiastic advocates claim, it will have a marked effect on future power-plant design and will encourage the use of higher steam pressures.

Steam Quality from Boilers

TEN years ago it was the practice to operate boilers around one hundred and sixty per cent average rating. Dry pipes of various kinds were developed and installed in drums of boilers, so that the steam leaving these drums seldom carried more than one-half of one per cent of moisture. This was known as commercially dry steam.

It is now common to operate boilers at much higher average ratings, usually two hundred per cent or more. Plants have recently been designed with large water-cooled areas in the furnace, with air preheaters, and with feed water heated to a high temperature by means of bleeder heaters. Certain of these boilers are designed to operate continuously at ratings of four hundred per cent or higher. Under these conditions the heat added by the boiler is largely latent heat. Hence the rate of ebullition in the boiler drum is much higher than would appear from the rating alone.

This condition introduces new and serious problems in boiler construction. The disengaging surface for the steam is limited by the surface of the water in the boiler drums, which must be of small diameter at high pressures. There is, as a result, a tendency for the bursting steam bubbles to carry water in suspension into the steam space, especially when the discharge headers from the water walls also enter the drum. The dry pipes, which were satisfactory under the earlier operating conditions, are often no longer able to function properly, so that steam with considerable moisture may leave the boiler drum. Such action decreases superheat and permits boiler-water impurities to enter the steam system, both of which are undesirable. This experience is by no means uncommon, as evidenced by the number of special steam separating devices that are now on the market, several of which have proved satisfactory in this connection. Engineers operating boilers at high ratings should give close attention to the quality of the steam leaving their boiler drums. The superheater may evaporate moisture, but cannot remove solids.

The quality in itself is not easy to measure. In the first place an average sample is not easy to secure, as no standard method of sampling is in universal use. The usual methods of sampling do not consider the rate of flow of the steam or its influence on the interpretation of the calorimeter observations. Besides, care has to be taken in making accurate calorimeter readings and in determining the normal of the calorimeter itself.

Evidently, the new operating conditions require closer study of the phenomena of steam generation and disengaging surface in boiler drums than formerly. The use of still higher pressures may also introduce additional complications on account of greater density and surface tension.

Ideas From Practical Men

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted

Causes of Low Speed and Torque of Induction Motors

When locating the cause, in an induction motor of low speed and torque, first ascertain if the voltage and frequency are correct. Low voltage decreases the torque and consequently the speed of the motor. If the frequency is below normal, it will cause a corresponding decrease in speed, since the speed varies directly as the frequency.

If both the voltage and speed are correct, the motor itself should next be given attention. Examine the windings for short-circuits and open-circuits. A short-circuit will probably manifest itself by causing the motor to take an excessive current and by overheating the coils. In three-phase or two-phase motors one phase may be open-circuited, thus making part of the winding inoperative with a decrease in torque. There may also be loose connections in the rotor winding, which will increase the effective resistance of this winding and thereby decrease the speed. The writer has known of cases where the connections between the cars and the end rings of squirrel-cage rotors have become so poor that the motor was unfit for service until the rotor was repaired.

If the windings are in good condition, ascertain what load the motor is carrying. Overloads will make the motor slow down and cause high temperatures. The bearings may be too tight or the shaft may be bent, thus causing excessive bearing friction. Should these efforts fail to disclose the fault, the air gap of the motor should be checked. The bearing may be worn or the rotor not properly centered in the bore of the stator, allowing the rotor to rub against the stator punchings. An interesting case of this kind came to the writer's notice some time ago, with an induction motor installed on the ceiling and belted to an emery wheel below. The tension of the belt caused one bearing to wear and allowed the rotor to rub against the stator laminations. Thus the motor had to overcome this friction in addition to operating the emery wheel and as a result the fuses were blown quite often, so the motor was taken down and sent to the local electrician.

The wear on the bearing was on the lower side, when the motor was suspended from the ceiling, but when placed on the floor the worn side was on the top of the bearing and did not affect the rotor's correct position. On the floor the motor was all right, and after it ran free for a short period it was returned to service and a set of larger fuses used. When the motor was put into place, it was tried several times and found to operate satisfactorily; but when the bearing had worn a little more the fuses blew. The machinist in the plant decided that the rotor was too large, and put it in a lathe and took off a cut of several hundredths of an inch, where the original air gap was only eighteen thousandths. The motor was once more returned to service, and was found to operate satisfactorily on light loads, but when grinding was attempted, any ordinary pressure exerted on the wheel would stop the motor altogether. The trouble was now caused by abnormal magnetic leakage, due to the greatly increased air gap. Matters were finally adjusted by installing a new rotor and bearings.

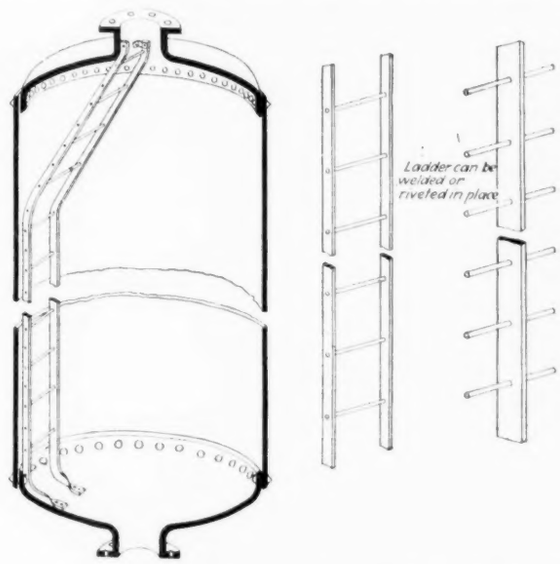
HARRY J. ACHEE.

Woodward, Okla.

Safety First in Tank Inspections

We preach safety on all sides, but it is not always practiced. Boiler inspectors do their utmost to prevent accidents by crawling inside of boiler drums and settings and searching for defects.

It is not only boilers that they inspect, for they are required to examine rendering tanks, air tanks and steam vessels of all kinds.



Use of ladder in large tanks facilitates inspection

To inspect small air tanks, kettles or rendering tanks is comparatively easy, but to slide down a rope or a frame ladder into a 30-ft. rendering tank or air vessel is dangerous, to say the least. A ladder is not always handy, and engineers seem to expect the inspector to use the next best thing he can find.

To eliminate such hazardous conditions and permit the inspector to carry out his work with safety, I would suggest the use of a ladder as shown in the illustration. The ladders should be made of steel and riveted or welded in place. Such ladders would not interfere with the operation of the tanks. They can be made in two or more designs as shown.

DOUGLAS E. BISHOP.

Detroit, Mich.

Connecting the Voltage of Open-Delta Connected Transformer

It sometimes happens in power-plant electrical equipment installations that open-delta connections of transformers are improperly made, which results in an unbalanced voltage on the three phases. Fig. 1 shows the correct connection if both transformers have the same polarity, and the connection Fig. 2 indicates a

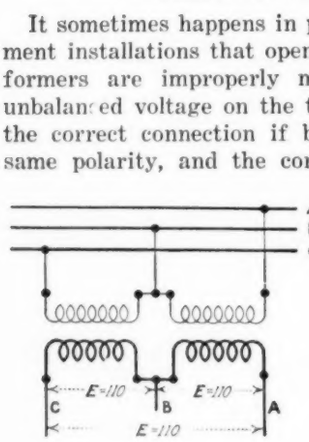


Fig. 1 — Correct open-delta connection

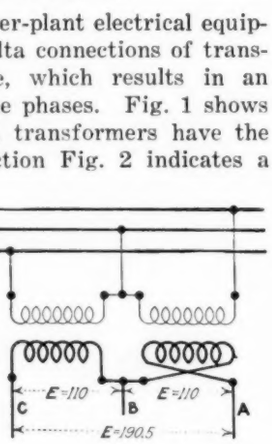


Fig. 2—Incorrect open-delta connection

common mistake made in connecting up the transformers. This connection gives a voltage between the two outside wires equal to the voltage of one transformer times 1.732, or in this case $110 \times 1.732 = 190.5$ volts, as shown. Such a connection is not easily detected unless a voltmeter reading is taken between each pair of leads from the transformers.

The unbalanced voltage may not be readily noticeable when the transformers are first put into service, since a voltmeter connected from *A* to *B* or *B* to *C* will read normal volts. A polyphase wattmeter connected to the transformer would give an incorrect reading.

Where power transformers are connected as in Fig. 2, motors connected to them will overheat. In one case one of the transformers had been rebuilt and when the leads were brought out through the case, they were arranged, by mistake, so that their polarities were reversed from the original. The result was overheating of motors and blowing of fuses until the fault was discovered. This emphasizes the necessity of checking the voltage from two transformers when they are connected open-delta to make sure that the connections are correct.

E. H. STIVENDER.

Los Angeles, Calif.

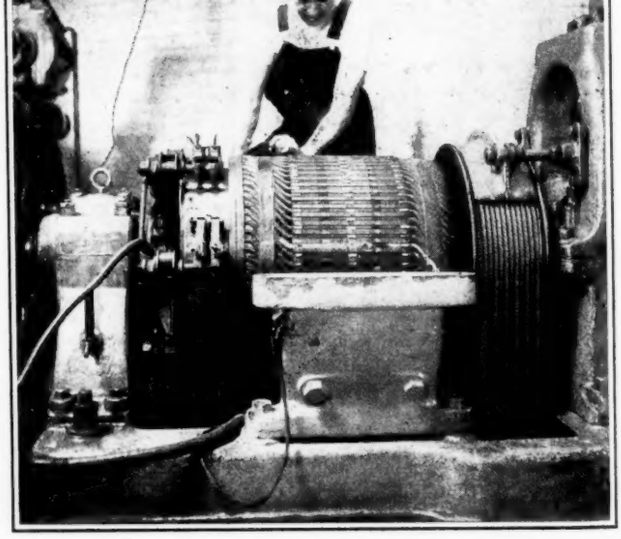
Repairing Elevator-Motor Armature in Place

Small and medium-sized armatures can generally be conveniently removed from the machine and taken to a shop when repairs are necessary. In elevator work or geared machine the armature can be easily disconnected from the brake wheel by removing the coupling bolts. Then the motor can be turned around in position and the coupling pulled off the shaft and the armature removed. These motors run at comparatively high speed and the armatures are easily handled. On direct-traction elevator machines the brake wheel, traction sheave and armature are mounted on the same shaft. In addition the motor runs at a slow speed, generally around 60 to 70 r.p.m., consequently the equipment parts are heavy. This makes it both advisable and economical to make all repairs, when possible, with the equipment in place.

If there is trouble in the armature coils, these can be reached by lifting the top half of the field frame off as in the figure. In this particular case the armature had one coil grounded and short-circuited by a piece of wire from one of the cables getting into the machine and being driven into the coil. A week or two before the armature coil failed a hoisting cable broke on the machine. Judging from the appearance of the broken cable, one strand failed first and caught on the guard over the traction sheave. As the machine was in motion, the strand was pushed back on the cable until resistance sufficient to complete breaking the cable was developed. While the strand was being pushed back on the cable, apparently broken wires were flying out of it and these were pulled into the motor by the field poles, since a number of pieces of the wire were found in the machine when the armature was repaired.

Fortunately, the ground and short-circuit in the coil blew the fuse and the fault was detected before the insulation on the entire coil was injured. To make the repair the top half of the field frame was removed and the armature bands cut off. This allowed lifting the top half of the damaged coil and reinsulating it without disturbing any other part of the winding.

To replace the bands the three coils in the bottom half of the field frame were connected in circuit and the accelerating switches on the controller blocked open.



Short-circuit in coil repaired with armature in place

Then by closing either of the reverse switches by hand, the motor revolved slowly to put on the new bands. A clamping device was bolted to the frame and used to maintain tension on the banding wire. Since the counterweights are heavier than the car, it is best before starting to put on the bands to run the car down near the bottom of the hoistway and run the bands with the motor turning in a direction to lower the counterweights, as this gives a smoother control.

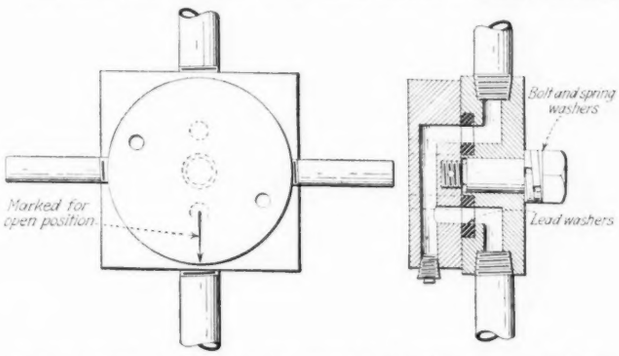
Philadelphia, Pa. M. E. WAGNER.

Simple Shop-Made Valve for Use on Oil Lines

The type of valve shown in the illustration was made in a shop where means were desired to flush out the oil on frequent occasions and blow out the pipes.

The advantage of using a disk valve seat is that it is readily machined without special facilities, the material is available from shop scrap and repairs or trouble are practically never met with.

The body of the valve is made from a block, drilled



Improvised disk valve for use in blowing out oil lines

through and tapped for pipes. Two lead washers form seats for the valve face, and a bolt with spring washers holds the disk against the valve face, the bolt being locked with a pin. The disk is drilled through for a lead with a plug to close the opening made in drilling. The bleeder holes are drilled entirely through the disk.

A valve of this type has several advantages when a cheap valve is required for a special purpose.

Washington, D. C. G. A. LUERS.

Maintenance Methods in the Power Plant

In the medium-sized plant the execution of repairs must be constantly under the scrutiny of the chief to secure the best results, regardless of the mechanical ability of the crew. As an illustration, a machinist in one plant spent an entire day grinding in a large globe valve on a steam line to an important process. As soon as steam was turned on at the main header, the valve was no tighter than before and he insisted that a new valve be put on. The chief was told the size and make of valve and he at once suggested the solution to the mechanic. "Since that valve has a removable seat, perhaps the leak is between the seat and valve body instead of between the disk and the seat." Upon close examination his statement was confirmed and the machinist started to remove the seat, which had to be cut out with a chisel.

While he was screwing in the new seat the chief watched him closely. After it was in as far as it could be screwed without danger of twisting off one of the lugs, the chief ordered it removed and counted the number of turns that it had to make to come free. He then covered the threads with a liberal coating of graphite and cylinder oil and counted the number of turns that it went in the second time. It went in one full turn more with lubricant on the thread and he asked the machinist if it required any greater pull on the wrench the second time. "Now you see the value of a little extra pains in doing these jobs. The next time that seat comes out, it will start with the wrench and will not be ruined with a chisel," said the chief. "Any screwed fitting on a steam line can be made on further with some kind of lubricant than without it and is less likely to rust on. When the seat rusts in and has to be cut out, we lose the main advantage of this type of valve, which is that the seat and disk can be replaced in a few minutes and the old ones ground in during spare time in the shop."

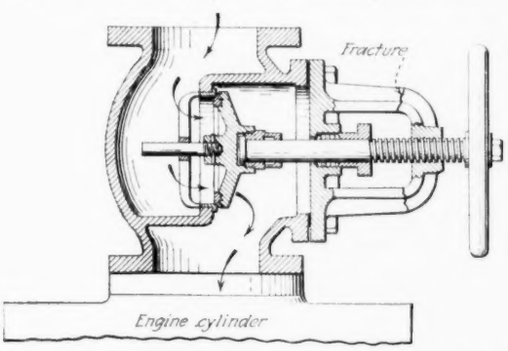
An oil pump in the same plant had to be run at top speed all the time to maintain the correct pressure, and repeated overhauling failed to help any. Coming into the plant on a holiday, the chief started the pump and at once a hissing noise was heard that was never apparent before. Placing his ear close to the discharge relief valve, the noise became louder and he knew at once that the valve leaked. During regular working hours the noise of other equipment caused the leaky valve to be inaudible, so it was never discovered by the operators. After the valve was ground to a good fit, he traced the discharge from this valve back to the supply tank and found that it entered at the top, but the pipe was so long that it extended well below the oil level. He had this pipe cut off so that the end was a foot above the oil level and any leakage that existed would then be visible. A marked reduction in pump speed and steam consumption was noticed, and the life of the valves, valve-springs and packings in the pump was doubled.

Thompsonville, Conn. G. H. HART.

Unusual Failure of Throttle Valve

A few evenings ago about 10 o'clock the night engineer at the factory telephoned me that the engine had started up full speed and that he could not shut it down. "The throttle turns round and round but won't shut," he declared. I hurried to the plant to find that the yoke of the throttle valve had snapped off on both sides, as indicated in the sketch, and that the steam pressure had pushed the valve wide open.

I used the boiler stop valve to stop the engine and



Throttle valve showing point at which yoke fractured

used it again in the morning as a throttle for starting up. I then had an oxyacetylene welder come and weld the yoke with the broken piece run up on the valve-stem thread till the edges met.

The break is one quite unusual, and I am at a loss for its cause except that the stem carried a heavy handwheel and I remember "spinning" the valve shut with considerable speed. The spinning momentum may have imposed a strain on the yoke that increased to the breaking point several hours after the shutdown, when the yoke was cooling off and shortening.

Vancouver, B. C. R. MANLY ORR.

Comments from Readers

Outwitting the Smoke Inspector

Replying to E. R. Webber's comment in the May 17 issue on "Outwitting the Inspector," it is my opinion that it makes little difference whether a steam jet or the usual process of wetting the coal is employed to control the smoke, the water vapor induced into the furnace produces the same result. The water must be evaporated, and heat is lost in making this change; the resulting steam absorbs heat, which in turn lowers the efficiency. It is true that sulphur burns to SO_2 (sulphur dioxide) provided combustion is complete, but if water vapor is present to any extent, we are likely to have H_2SO_3 (sulphurous acid) or H_2SO_4 (sulphuric acid) vapor. The corrosive effects of these are too well known to require further mention.

Some time ago I conducted experiments on two water-tube boilers, the fuel used being Illinois slack. The boilers were thoroughly cleaned and inspected. One was fired with dry coal and the other with wet coal. After 45 days a thorough inspection was made. In the boiler that had been fired with the practically dry coal the tubes remained clean, but in the boiler fired with wet coal a thin scale had formed on the tubes at the last pass. Some of this scale was removed, and a trace of sulphuric acid was found. There are other objections to the introduction of moisture into the furnace, that are as important as efficiency. If Mr. Webber cares to take the pains, he can satisfy himself and gain some valuable information.

M. V. MILLER.

Indianapolis, Ind.

Current Transformers Connected Two in Parallel

In the June 7 issue, page 888, is an article headed, "Wrong Transformer Connections Cause Improper Loading of Turbine," which I believe should be clarified somewhat. In the fourth paragraph it is stated: "But upon tracing out the connections on the feeder ammeters, it was found that two 1,000- to 5-ampere current transformers on each feeder were connected in parallel to the one ammeter as in the figure, thus giving approximately a double reading."

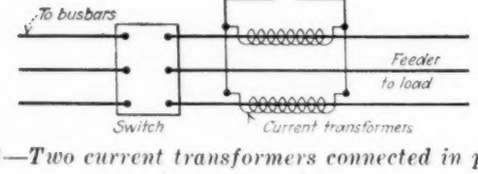


Fig. 1—Two current transformers connected in parallel to one ammeter

I assume that the circuit shown in Fig. 1 is either three-phase or two-phase three-wire. If the former is the case, then the connections shown are correct and the current read by the ammeter will be that in the second phase of the circuit, which corresponds to position 2 of a three-phase ammeter switch.

If the circuit, however, is two-phase three-wire and the connection is as shown, then the current indicated by the ammeter would be that of the common leg, or 1.41 times the current in either outside leg, assuming, of course, balanced load.

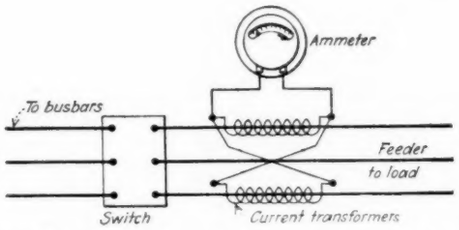


Fig. 2—Two current transformers connected vector parallel to one ammeter

A connection known as vector parallel on a three-phase circuit, Fig. 2, differs from that shown in Fig. 1, in that the current transformers are cross-connected instead of being connected straight through. This connection gives a current in the ammeter equal to 1.73 times the current in either of the outside legs, and it may be that Mr. Wirtanen actually had this connection in his plant, but failed to show it correctly in the diagram.

HARRY G. WOOD.

New York City.

What Made the Motor Howl?

In the issue of May 31 there is a question asked by C. Dickerson under the caption "What Made the Motor Howl?" which requires a good deal of explaining. Noise caused by the rotor of a squirrel-cage motor is not the result of grounding, so that the direct answer to Mr. Dickerson's question is this—the noise had no possible connection with the grounding or the insulation of the winding of the rotor. The only reason why Mr. Dickerson feels that there is a connection between them is because the noise ceased after the rotor windings had been insulated.

If the only thing done had been to insulate the windings without removing the bars from the rotor, the noise would have been just the same after insulating as it was before. However, it happened that not only were the bars insulated, but the end connections were again made.

It is evident that the end connections where the motor was howling were not good electrically. After insulating the rotor, however, the end connections were properly made and it was because of the elimination of the open-circuit or a connection of higher resistance that the change from noisy to quiet operation was made.

There is much to be said in connection with noise

in a squirrel-cage induction motor. There are many factors that affect it, but none of the factors that determine noise are dependent in any way on the insulation of the rotor winding.

It is always preferable to build a squirrel-cage motor without insulation of the rotor winding, because insulation takes up room. Outside of this, however, it has no effect either favorable or unfavorable.

Cleveland, Ohio. J. F. LINCOLN, Vice-president,
The Lincoln Electric Company.

The Air-Lift Pump

There is an old saying to the effect that the successful shoemaker must stick to his last. That may have been true in the old days when trades were nearly secret societies, but in our era the shoemaker can learn something to his advantage outside his immediate field and so can the engineer.

The article by W. V. Fitzgerald in the May 24 issue on the "Air-Lift Pump" is an example. I wonder how many steam boiler engineers realized that this article explains the whole theory of circulation in water-tube boilers and gives some valuable hints on their design.

Substitute for the air slugs mechanically introduced into the eduction pipe of the pump, the steam bubbles produced by the heat of the furnace in the water tubes of the boiler, and the analogy is perfect. Three sources of loss are mentioned for the air-lift pump: (1) Friction of water moving in the pipe; (2) loss due to slip of the bubbles; (3) loss due to discharge velocity. All these have a counterpart in the steam boiler, although engineers frequently overlook the fact. Steam bubbles and hot water have friction where flowing in boiler tubes just as air bubbles and cold water do in the discharge pipe of a pump. Friction cuts down the water output in each case, and the boiler designers can profit by the pump man's experience and improve their boilers by eliminating friction in the water circuits. I fear that the pump designer would severely criticize a number of boilers on this point.

Mr. Fitzgerald emphasizes the effect of the size of the bubbles on the efficiency of the pump and reports that special foot-pieces to produce small bubbles are used. Just as small air bubbles have less slip in the pump, so do small steam bubbles produce better circulation in the boiler. The boiler designer does not have perfect control over the size of steam bubble, but he can arrange the circuit so that little opportunity is afforded the small bubbles to amalgamate, and of late, realizing that the specific volume of steam decreases with the pressure, he has kept the bubble size down by operating at high pressures

On the third item, discharge velocity, the analogy is not so direct, as the boiler is a true circuit while the pump has no return path, but if the boiler man realizes that there is a discharge velocity at the top of the upcomers, he is a long way on the road toward eliminating wet steam. Realizing that this velocity exists, it is at once appreciated that it will project water into the steam space and then the problem becomes one of removing this water either by heat or by trapping devices.

Mr. Fitzgerald could give the boiler man some more valuable help if he would tell the effect on the amount of water pumped when the quantity of air is progressively increased. At first the water output would increase, but carried to a ridiculous extreme we can imagine so much air admitted that the discharge pipe would be full of air. There is some point where the water discharge is a maximum, and possibly this is influenced by the friction in the pipe. The corresponding point in a steam boiler would be the steam output, or rating, where the greatest amount of water would be circulated. This would be the point of maximum heat transfer, and boiler operators would like to know where it is for various types of boilers. E. S. SMAIL.

Oak Park, Ill.

Is An Oil Film Destroyed?

In the May 31, 1927, issue of *Power*, in the "What Do You Know" column, question No. 5 reads as follows: "After the piston of an oil engine has moved on its power stroke, is there a film of lubricating oil on the upper part of the cylinder walls, uncovered as the piston advances?"

The answer given to this question is in the negative and assumes that since the combustion temperature is above the burning point of the oil, the film must be burned and the walls left dry.

It is, of course, true that the maximum temperature in the cylinder is far above the oil fire point. It is also true that, owing to the resistance of the cylinder wall to heat flow, the temperature of the inner wall surface is above that of the outer surface, and still farther above that of the cooling medium. Nevertheless, does it seem reasonable to suppose that a film of oil spread over one side of a water-cooled metal wall and in intimate contact therewith would be entirely consumed when exposed for a small fraction of a second to a gaseous flame, even though the latter may have a temperature as high as 4,000 deg. F., or even more? In fact, is not that possibility one of the principal things that the cooling system is designed to prevent?

Anyone experienced with gasoline engines has seen spark plugs fouled, not by solid deposits of carbon, but by many small particles of carbon suspended in unburned oil which bridged the gap between the plug electrodes. It may be argued with perfect truth that this condition was brought on by a large oversupply of oil; it is equally true, however, that the spark-plug electrodes are maintained at a much higher temperature than the cylinder wall.

On the whole, if the question is debatable at all, certainly there is a great deal of evidence tending to contradict the answer given.

LEONARD C. PRICE, Research Engineer,
Engineering Experiment Station,
Fayetteville, Ark. University of Arkansas.

[Experience shows that the oil film does disappear. This has led to the adoption of timed oil introduction in large engines, by which means the oil is spread upon the piston on the up stroke, permitting the cylinder wall to be covered with a film removed from the fire. This film must be renewed after each combustion stroke. The degree to which the film is destroyed obviously depends upon the cylinder temperatures, duration of combustion, etc., and, of course, that part of the cylinder walls unexposed during the time of high temperature retains its film. In Osborne's "Power Plant Lubrication," the editor's contentions are fully upheld. —Editor.]

Power an Outstanding Subject at A.I.S.E.E. Convention

DURING the week of June 13 to 18 the Association of Iron and Steel Electrical Engineers held its twenty-third annual convention and iron and steel exhibition in Pittsburgh, Pa. This year's convention and exhibition were just as successful as those held in previous years. The exhibition, which was held in the Syria Mosque, included 150 exhibits of power equipment, its control and maintenance, pertinent to the iron and steel industry. Pittsburgh, being one of the largest steel producing centers in the country, afforded many an opportunity to visit the exhibition, and it is estimated that the attendance at this feature exceeded 20,000.

Special features were the six technical sessions, at which 15 papers and reports were presented and discussed; the visit to the new structural steel mills of the Carnegie Steel Company at Munhall, Pa.; the reception dance and entertainment on Monday evening; and the dinner dance at the Hotel Sherley, the latter on Wednesday evening.

Electrical Development Report

At the Monday morning session the report on Electrical Development in the Iron and Steel Industry was presented by W. H. Burr, chairman of this committee. Outstanding in this report are the large-sized power generating units and power drives being installed in the steel mills. Also the almost complete electrification of steel mills. During the year 1926 there were purchased 148 main-roll drives requiring motors ranging in size from 300 to 8,000 hp.

Where a few years ago these drives were almost entirely steam engines, today new drives are in almost all cases electric motors and in many cases the old steam engines are being replaced by motors. This allows installing the boiler and power generating equipment in large centrally located generating stations and transmitting the power electrically to the various mills.

The short time in which a change over from steam drive to electric motor can be made has been an important factor in these conversions. Attention is called to one case in the report where, in 122 hours from the time the mill was shut down, it was ready to run again. This change included removing the steam engine, building a new foundation for the 3,000-hp. motor and installing this motor. In a considerably larger installation the change was made in 147 hours.

The size of steam mill power generating units has increased until they have reached proportions comparable with those found in large central stations. In this respect the report directs attention to one 30,000-kw. and three 20,000-kw. units that have been ordered for steel-mill service. Two of the 20,000-kw. machines are for one company.

Another important unit is a blower for blast-furnace operation that is driven by a 10,200-hp. turbine.

It is only recently that mercury-arc power rectifiers have been seriously considered in this country, but in this brief period, according to the report, 50,000 kw. capacity of these units has been installed for steel-mill service.

Direct current is being used extensively in steel mills today where variable-speed drives are required. A discussion of the report led to a consideration of the merits of rotary converters and motor-generator sets. The rotary converter has the advantage of requiring less space and has a higher efficiency, but the motor-generator set, providing greater flexibility of power factor and voltage control, has been more generally adopted.

STEAM-TURBINE driven generators with capacities ranging up to 30,000 kw. installed in steel mills, replacing an old engine drive on a rolling mill by a 3,000-hp. motor with the mill shut down for only 122 hours, safe operation of power systems, the applications of anti-friction bearings, the applications of synchronous motors in steel mills, and modern steel-mill boiler plants were some of the subjects discussed at the Association of Iron and Steel Electrical Engineers Convention. In one mill the power factor has been increased from around 60 per cent to about 95 by the use of synchronous motors. A steel plant having 168 old boilers in seven plants has replaced them by one plant in which there are eight boilers, each having 22,250 sq.ft. of water-heating surface.

Although attention was called to cases where rotaries have given trouble, other installations were cited where their operation had been entirely satisfactory in steel-mill work. The maintenance cost for the motor-generator set would probably be less than for rotary converters of equal capacity and operating under similar conditions.

Efficiency of a large motor-generator set, with the motor operating on system voltage, was given as 90 per cent. For a rotary converter of the same capacity, with its transformers, the efficiency was given at from 93 to 94 per cent. The losses in the low-voltage connection between the transformers and rotary were not included in this.

Safety Engineering Session

At the session of the Safety Engineering Division, at which C. L. Baker presided, three papers on electrical safety work were presented and discussed. In his opening address Mr. Baker called attention to the achievements that have come about in accident prevention through the safety-first movement.

In outlining what had been accomplished by this movement, Mr. Baker quoted from a report made by L. C. Chaney, statistician of the United States Department of Labor, which showed that for 1910 there were 74.7 lost-time accidents for every 1,000,000 hours worked in the steel mills of the country. In the electrical departments of these mills this figure was 62.7. By 1923 these figures had decreased to 33.2 and 17.6 respectively. For 1926 figures for the combined operation of the plants only were available, which were given as 28.11. In other words, the lost-time accidents per 1,000,000 hours of labor performed have decreased from 74.7 to 28.11 in 16 years. The electrical departments have greatly excelled this downward trend in accident prevention.

A. N. Cartwright read a paper on "Safe Practices in Connection with the Operation of High-Tension Power," which described the methods used by the West Penn Power Company for safe and reliable operation. The operation of high-tension power facilities by well-organized companies has become fairly well standardized and is generally under the jurisdiction of a load-dispatching division and is supervised by a man of long experience, who is chosen for his particular ability in the line of work this operation involves. "This man," said Mr. Cartwright, "is never the optimist, but is of the show-me type. He must be resourceful, have accurate thinking power, quick with judgment and have most of his planning done before the actual need for action arises."

On the system with which Mr. Cartwright is associated, the operators are under a coaching system, both by the load dispatchers and the men whose duty it is to visit each station, check over the equipment and the operators' understanding of the rules and orders, putting up to the operators hypothetical problems of trouble and receiving their answers as to what action they would take. An analysis is made of all operating errors, and if possible, rules are formulated to prevent their occurrence. Neglect of rules or inexcusable mistakes are followed by dismissal or transfer to less important work.

A second paper, on "Safe Practices in Connection with High-Tension Power," was presented by T. E. Hughes and dealt with the steel mill's side of the problem as represented by the conditions at the Duquesne Works of the Carnegie Steel Company. Mr. Hughes calls attention to an analysis that was made a short time ago to determine the principal contributing cause of electrical industrial accidents, in which it was

found that some phase of man failure predominated in nearly every instance.

It was suggested that in order to emphasize the conditions that exist and that must be overcome among the men doing this dangerous class of work, it is desirable to review these causes and afterward endeavor to provide means of eliminating them. The seven basic causes given are: Ignorance, haste, dependence on others, thoughtlessness, lack of discipline, defect in physical condition, and inadequate illumination.

After analyzing these causes of accidents and giving some general rules for safe operation during normal and emergency periods, Mr. Hughes expressed the conclusion that by far the most important feature in accident prevention is education.

Much can be done to avoid accidents occasioned by thoughtlessness, haste and dependence on others, by safety propaganda in the form of meetings, demonstrations, talks by foremen, the explanation of accidents, etc. A well-managed system insists on obedience to orders; the more nearly discipline approaches the military standard the fewer the accidents will be. Safety devices cannot be substituted for ignorance, thoughtlessness or disobedience to orders, but where good management exists, systems of instructions, short-circuiting and grounding devices are effective checks to carelessness and lapse of memory. Instructions and safety devices should be simple, orders as few as possible, and in the last analysis a simple sign used in connection with short-circuiting chain is sufficient to prevent a large majority of potential accidents.

Anti-Friction Bearings

Three papers were presented on the application of anti-friction bearings to roll necks of steel rolling mills. Although these applications may not be of direct interest to the power engineer, the size of the bearings and the severe conditions of load, water, temperature and dirt under which they operate may be of concern, as such bearings are coming into use on power-plant equipment.

Where bearing friction loads are high, the anti-friction bearings have a distinct advantage over sleeve bearings, in the torque necessary to start the load. Reducing the break-away torque may make it possible to use a simple type of motor on the load. At least it will make it easier for the motor to meet the conditions imposed by the drive.

As to power savings, instances were cited where, on rolling mills, a reduction of 40 to 60 per cent had been made. These figures, however, will probably require qualifying as to the conditions under which they were obtained. On motors the power saving from the use of anti-friction bearings is practically negligible.

In the discussion the advisability of the general adoption of anti-friction bearings for all classes of motors was questioned and the appointment of a committee was suggested to make a study of the relative merits of anti-friction and sleeve bearings on motors. Although a report made in 1923 showed that a large percentage of winding failures in motors having sleeve bearings was due to oil getting out of the bearings and onto the windings, it was felt that this would not be the case with motors of modern design. In the first place, the windings are insulated to stand better the effects of oil and dirt, and second, the bearings are designed to keep oil in and dirt out.

There was considerable discussion on the lubrication of anti-friction bearings. Apparently, up to the present time no satisfactory lubricant for all conditions has been developed. For certain requirements some lubricants are giving excellent results, while for others the problem has not been so satisfactorily solved, especially for very low or high temperatures.

A paper that attracted a great deal of attention and dealt with a subject that has far-reaching possibilities of improving the power factor of power systems, was "The Application of Synchronous Motors to Steel Mills," by Harry A. Winne. In presenting this paper, the author said that at the beginning of 1925 only about 3,500 hp. of synchronous motors were installed on rolling mills. By the end of last year the figure had increased to 35,000 hp., and the increase for this year would probably be in a greater ratio. One motor of this type is in operation, having a continuous rating of 9,000 horsepower.

The possibilities of power-factor correction and the starting characteristics of these motors received considerable attention. One mill was mentioned in which, by the use of synchronous motors, the power factor had been increased from about 0.60 to around 0.95. The 9,000-hp. motor is started on reduced voltage, but so far as the motor is concerned, according to Mr. Winne, it could be started by connecting directly to the line, but would take an initial inrush of about 60,000 kva., or about six times normal full load.

Burning Blast-Furnace Gas Under Boilers

A paper on "Recent Boiler Plant Installation at Edgar Thompson Works, Carnegie Steel Company," that is indicative of the transition taking place in steel mill boiler plants, was presented at the Wednesday morning meeting by R. D. Abbiss. As an introduction to his paper Mr. Abbiss said:

"Production incessant and ever increasing is the creed of the modern steel plant. A continuous supply of steam and electrical energy unlimited to the extent that output shall not be curtailed is essential to this production. While this continuous reliable service has been, and will continue to be, the first requirement of the steel-works generating units, efficiency demands more and more attention. The design of the modern steel-works boiler plant, although it may be comparatively diminutive from the viewpoint of the public-utility man, is a matter of careful study and individual design in order to obtain the highest economical operating efficiency together with positively continuous and reliable service. Both of these factors were kept to the foreground when adopting the plan of finally replacing the seven boiler plants, containing 168 boiler units located at various points in the plant in near proximity to the steam-consuming units with two central power plants."

The 168 old boilers were replaced by eight of modern type, each having 22,500 sq.ft. of water-heating surface. This installation is modern in every detail, being equipped with air preheaters, forced- and induced-draft fans and automatic combustion control.

The boilers are of the Stirling type and are set high, 41 ft. 1½ in. above the firing floor. When considering this high setting, it was realized that difficulties had been encountered with high furnace walls that made the maintenance costs high, these troubles being caused by the large compression loads that have to be carried on the lower part of the brickwork. The large furnace volume allows more complete combustion in the furnace, which results in higher temperatures, and the large furnace volume also permits higher ratings to be obtained with correspondingly higher temperatures. In view of these facts the settings were built of first-quality firebrick, using non-clinkering furnace blocks to prevent clinkering and slag adhesion to the walls above the stoker and in the clinker-grinder pit. This type of setting has proved entirely satisfactory.

In addition to the automatic combustion-control system to regulate the boiler's operation, they are well equipped with instruments to give a complete record of their performance. The total amount of feed water is metered, and each boiler is equipped with a steam-flow meter, and the total steam delivered to the line is measured by two main steam-flow meters. CO_2 indicators and recorders are installed on each boiler and temperature and pressure indicators and recorders where required. The gas is measured by a meter installed in the 120-in. main.

Since going into operation, the average rating of the gas-fired boilers has been 206.6 per cent and the highest one-half hour peak 327 per cent. Stack temperatures on these boilers range from 420 to 570 deg. F., and the temperature of the air to the furnace is 460 to 560 deg. For the coal-fired and coke-breeze-fired boilers the stack and furnace air temperatures are lower than for the gas-fired boilers.

No operating efficiency figures were given, as complete tests have not been made of the plant, but it was brought out in the discussion that where the efficiency of the 168 old boilers that were shut down probably was not much above 40 per cent, the new boilers would have an efficiency around 80. Some trouble has been had with the dust in the gas collecting on the boiler tubes and arches, but this feature is being taken care of. In view of this experience it was considered that washing the gas before sending it to the boiler furnaces was justified.

Attention was called to the growing importance of blast-furnace gas for power generation. The kilowatt-hour from the blast-furnace gas per ton of pig iron produced has constantly increased until it is now above 150, and 200 is being approached. About 50 per cent of the heat in the coke entering a blast furnace is available in the gas. This new boiler plant was considered a great forward step in steel-mill practice of utilizing blast-furnace gas, and it was predicted that even larger boiler units would be installed

Boiler Feed Water Studies Reported at Water Works Convention

ONE of the most comprehensive undertakings ever attempted in this country in problems of steam generation, as affected by boiler-feed water, is the series of studies and research work now being carried on by the Boiler Feed Water Studies Committee sponsored officially by the following organizations: American Railway Engineers Association, American Water Works Association, National Electric Light Association, American Society of Mechanical Engineers, American Society for Testing Materials and the American Boiler Manufacturers Association. At the conference of Committee No. 19 of this representative body at the annual convention of the American Water Works Association, held in Chicago, June 6 to 11, seven papers were presented—four at a morning session relating to feed-water treatment as applicable to stationary practice and three in an afternoon session devoted to railway practice.

Mr. Powell Reviews the Progress of the Work

Sheppard T. Powell, chairman, reviewed the progress of the work. The present organization consisted of an Advisory and Editing Committee and nine technical committees, or subcommittees. The problems assigned to these committees were: Corrosion; embrittlement; condensers, evaporators and deaërators; priming and foaming. The funds to carry out this program will amount to between $40,000 and $50,000 a year for a period of three to five years. The Finance Committee is enlisting the support of the various public utilities, manufacturers and other groups. As soon as funds are available, active work is to be started.

Some of the important problems to receive attention this year are the following: Prevention of after reaction in chemical softeners; the economies that may be effected by the use of zeolite softening or chemical softening in conjunction with evaporators; embrittlement of boiler steel and the use of inhibiting agents other than sulphates; the effect of trade waste on surface condenser operation and in boiler-water treatment; the value and economy of continuous blowdown apparatus; the importance and value of electrolytic methods of prevention of scale and corrosion; studies on the corrosion of boiler metal, condenser tubes and other equipment; causes and method of control of foaming and priming.

Zeolite Water Treatment

An important contribution to the morning session and in fact to the general subject of feed-water treatment was a paper on "Zeolite Water Treatment in a Large Central Heating Plant," by Prof. Alfred H. White, J. H. Walker, E. P. Partridge and L. F. Collins. The plan of treatment was worked out in advance in the laboratory and then carried out in the Beacon Street heating plant of the Detroit Edison Co. with remarkable success. After consideration of the various methods of treatment, the zeolite system was adopted. Results of the extensive preliminary laboratory investigations to determine the possibilities of the removal of carbon dioxide from a zeolite-treated water by means of sulphuric and phosphoric acids as well as actual operating results from the plant are given in the paper. The treating system is described, and diagrammatic sketches illustrate an interesting acid proportioning device for feeding dilute acid in exact proportion to the amount of water treated, and a continuous blowoff system to keep down concentration in a plant requiring about 90 per cent make-up water. It will be recalled that the boilers are the largest yet built, as to evaporating surface, each containing 41,500 sq.ft. of surface, and are capable of operating up to 300 per cent of rated capacity at a pressure of 150 lb. A more complete abstract of this paper will appear in an early issue.

Discussion turned to the possibilities of accomplishing the same results in other ways such as a lime and soda pretreatment of a zeolite water with no acid neutralization, the use of soda ash, etc., at a lower cost and with less sodium and corrosive action. Comment was made on the findings in the paper on the use of phosphoric acid. Its use introduced less acid into the water and provided a means of combating alkalinity in the easiest way. Another factor of importance was the certainty that with a phosphate radical in the water, no scale would develop.

Five-Year Program of Research

As a basis from which to start discussion, Prof. C. W. Foulk, of Ohio State University, offered certain suggestions for a five-year program of research on the boiler-water problems of foaming and priming, electrolytic scale prevention, internal treatment and the behavior of zeolite-softened waters. It was the speaker's suggestion that the problem of foaming and priming should be studied along three lines. To learn something of the fundamental causes of foaming, a physico-chemical study of those properties of solutions that have to do with foam formation should be made. Such data as the surface tensions and surface viscosities of a number of typical boiler waters and concentrates should be obtained, and the properties of the suspended solids in boiler waters which stabilize the films also should be studied, particularly the relation of these properties to anti-foams. Extensive and systematic series of experiments should be carried out in a small boiler to establish the effects upon foaming and priming of the various soluble salts, kinds of suspended solids and the various oils and organic matter that may be in a boiler water. A limited number of typical situations as suggested by the foregoing experiments should be tried in a full-sized boiler, and such interesting cases of foaming and priming as may come to the notice of the committee should be studied in the field.

Electrolytic Scale Prevention

Electrolytic scale prevention should be studied along several lines. There should be a physico-chemical investigation of the underlying causes of the non-adherence of scale when forming in an electrical field, particularly, to demonstrate whether non-adherence of scale is associated with an electrical field. Systematic experiments should be made in a small boiler in order to get suggestions as to the most favorable conditions in practice, and installations in commercial boilers in actual use should be studied.

Under the comprehensive heading internal treatment, there was one topic outstanding in importance that long ago should have been made the subject of an extended series of systematic experiments, namely, the action of certain forms of organic matter in water in preventing the adherence of hard scale, which might be called the protective colloid effect. This project should be started by a careful laboratory study of the causes of scale adherence in boilers and the behavior of colloids in preventing such adherence, followed with experiments in a small boiler and finally studies and experiments in the field with commercial boilers. Another project under internal treatment is a study of the so-called metal treatments, or compounds that are supposed to produce coatings on the metal of the inside of the boiler and thus prevent scale and corrosion. No details were suggested for zeolite-softened waters other than the general course given for the other projects.

Research Work Planned to Be Done in the Universities

To carry out these projects the plan was to have the research work done at the universities of the country, where all the facilities such as libraries, laboratories, equipment and instruments were available. Subcommittee No. 3 should put the plan into operation and follow the work, but the actual scientific and engineering direction of a project should rest with some professor whose duty would be to guide the work and finally write up the results for publication. The more scientific part

of the work might be entrusted as a thesis to particularly capable candidates working for a doctor's degree under the direction of one of the professors. The creation of water research fellowships would automatically provide assistants. Work of a routine character could be conducted by research assistants and field men, after given a preliminary training, and special investigators might be secured from the holders of fellowships who have developed special fitness and inclination for such work.

According to the speaker there was no part of the plan outlined that was not in actual operation in some form or other in one or more of the universities of the country, the one new point being the organization of a related number of research problems under one directing head and the allocation of the different problems or projects among several independent universities.

In the discussion mention was made of the offer of the Bureau of Mines to co-operate and very much lighten the expense for experimental undertakings.

J. B. Romer, of the Babcock & Wilcox Co., gave a popularized address dealing with the principal troubles arising from impurities in boiler feed water, such as the various minerals present, the suspended matter and acid, and their effects on boiler operation, including brief mention of the corrosive effect of pure water, owing to the presence of dissolved oxygen and hydrogen ions. A more complete abstract of this paper will appear in a later issue.

In the afternoon session dealing with the treatment of feed water for locomotive boilers, W. M. Barr and R. W. Savidge, of the Union Pacific System, reviewed the various partial and complete softening methods in use on the railways and the difficulties encountered. J. F. Raps, of the Illinois Central System, pointed out the value of boiler-water treatment to the mechanical department in reducing repairs, while E. M. Grimes, of the Northern Pacific Railway Co., discussed the same general subject from the viewpoint of railroad efficiency.

Packing for Hydraulic Machines

A RECENT report made by the Hydraulic Power Committee of the National Electric Light Association, contains the results obtained with various forms of packing for waterwheels and their auxiliaries. The experiences of many operating companies are summarized in a table, and from these records and a study of the physical properties of packings, the following conclusions are drawn and given by the committee in its report:

Conclusions

Flax packing is the most generally employed. As commonly used, it forms a satisfactory hydraulic seal, but has a tendency to cut the shaft. To reduce the cutting to a minimum, strict attention should be given to providing lubrication.

Long-fiber flax has a much longer life than short-fiber flax.

Hemp packing may be used if strict attention is given to impregnation and lubrication.

Hemp packing has a shorter life than flax packing, for which reason it is not generally used on hydraulic units.

Cotton packing has greater absorbing properties for lubrication than flax or hemp, hence the tendency to cut the shaft is lessened.

Cotton packing has not been in use on hydraulic machines a sufficient length of time to determine its average life.

A granulated-wood and metal packing, impregnated by boiling processes, is being used quite extensively with satisfactory results. It has a longer life and wears less on the shaft than flax.

Manufacturers should provide a renewable wearing sleeve on the shaft through stuffing boxes.

The success or failure of a packing oftentimes depends upon the mechanical ability of the attendant to make proper applications.

The quality of the same kind of packing varies greatly with different grades.

Braided-Flax Packing

The best flax for packing must be soft in quality, with a long fiber and of sufficient strength to give it stability. The Archangel flax obtained from Russia before the War met these requirements admirably. This source of supply is not now used by American packing manufacturers.

Belgium, Ireland, Scotland and Russia are the leading flax producers, although the growth of flax in the United States is rapidly on the increase. Flax fiber that closely equals the Archangel flax is now being produced at several sources.

Asbestos Packing

Long-fiber asbestos packing, impregnated with a graphite lubricant, has given good results with long life in one large, low-head plant, that of the Pennsylvania Water & Power Co., at Holtwood, Pa. This packing is manufactured from long-fiber asbestos, braided either round or square by the same method employed in producing textile packings.

This style of packing has been generally adopted for all classes of hydraulic service in this plant, where pressures vary from 10 to 20 lb. for mainshaft stuffing boxes and up to 275 lb. pressure for both low and high-pressure stuffing boxes in centrifugal 6-stage governor-control pumps. It is also used in the high-pressure 275-lb. stuffing boxes of the waterwheel servomotors. In no case has it been necessary to use special lubricants after the packing is in use.

Hemp Packing

Hemp packing has proved less satisfactory than flax, although its use, when strict attention to lubrication is given, may be made satisfactory, as evidenced by the Georgia Railway & Power Co.'s report, which states: "For all our hydraulic turbines long-fiber Italian hemp packing, boiled in tallow, has proved the best, and if packing is properly treated by reboiling in tallow occasionally, the life of the packing may be prolonged for approximately two years. In all cases where it is convenient, oil cups are placed on the stuffing boxes, allowing about three drops of oil per minute. If packing is not properly treated and lubricated, the shaft will be cut or grooved."

Granulated-Wood and Metal Packing

The granulated-wood and metal packing, which is coming into quite general use, is composed of about equal quantities of soft lead and white pine granules or small chips. The proportion of wood to lead is varied somewhat for different services.

The lead is treated by a process that removes some of the alloys, causing the lead to become soft, yet still retaining the toughness inherent in the original metal.

The lead is boiled in oil and chemicals to produce an absorption of lubricant. The wood granules are likewise boiled in oil until thoroughly saturated with the lubricant. The wood and lead are then mixed with graphite and the finished product placed in containers made of cotton, which wears away from the bearing surface when the packing is put in operation. Experiences to date indicate a long life with this packing with very little wear on the shaft.

Plastic-Metallic Packing

Plastic-metallic packing is made by several of the leading packing manufacturers. It may be procured pressed into rings of a definite diameter or in bulk form. In the latter case the material is simply tamped into the stuffing box against header rings.

The Southern California Edison Co. is the only company reporting its use in connection with hydraulic machines. This single report looks particularly favorable, as it shows a life to date of 5½ years with the shaft in good condition.

Braided-Cotton Packing

Wear on the shaft in the stuffing box is in direct proportion to the amount of friction. As cotton will absorb and hold lubricant better than flax, it naturally would cause less friction and wear on the shaft.

The California-Oregon Power Co. questionnaire reported a short life for cotton packing, but communications received at a later date attribute the short life to operators maintaining the gland pressure too high. They now believe the packing to be altogether satisfactory and expect in the future to use it at all plants.

Cotton packing used for high-speed boiler-feed pumps in the district about Portland, Ore., has proved exceptionally satisfactory as to freedom of wear on stuffing-box bushings.

Several other packings not covered in the foregoing discussion have been used to a limited extent with fairly satisfactory results. Among these are "three-piece diagonal" and "C" rings.

National Board of Boiler and Pressure Inspectors Meets in Nashville

Papers Presented Prove Interesting and Instructive—Convention Affords a Means for Co-ordinating Inspectors' Activities

PLENTY of action characterized the Fifth Annual Convention of the National Board of Boiler and Pressure Vessel Inspectors held at the Hotel Hermitage, Nashville, Tenn., June 14-16.

Owing to the inability of Chairman J. F. Scott to be present, the meeting was called to order by Vice-Chairman C. V. Thomas at 10 o'clock. Mr. Thomas introduced Mayor H. E. Howse of the City of Nashville, who delivered a cordial address of welcome. He spoke of the resources the South had to offer to industrial activities and complimented the society for the work it is accomplishing. The welcome that Nashville extends to the inspectors was emphasized and his address was closed by presenting the keys of the city.

C. W. Obert explained the circumstances of the death of a brother that compelled Chairman J. F. Scott to be absent and expressed for Mr. Scott the regrets he felt for his enforced absence. A telegram of sympathy was forwarded to Mr. Scott. Secretary C. O. Myers read Mr. Scott's annual address, a draft of which follows:

President's Address

"For several years we have endeavored to meet annually to check ourselves and make notes relative to our activities, and when we meet it is for the purpose of discussing and assisting in co-ordinating our activities with the viewpoint of further improving and simplifying our work. Therefore, our meeting should act as a clearing house by all interested in our work, whether they are or are not members of this body. This should be the time when objections, criticisms and constructive suggestions should be presented with a feeling of an obligation of duty.

"The members of this board are members of the Conference Committee of the Boiler Code Committee of the American Society of Mechanical Engineers. The problems of the Boiler Code Committee of the A. S. M. E. are our problems. Therefore a uniformity of opinions is vitally necessary in a board of this kind in order to eliminate a multiplicity of opinions presented to the Boiler Code Committee.

"We shall be known by our actions and likewise gaged. It is therefore obvious that every subject that comes before us should be given much thought before arriving at a conclusion, regardless of its simplicity or complexity. It is pertinent to feel that the man most careful in arriving at a conclusion would be a greater asset to his associates, because he would be confident in his decision and therefore dependable.

"Seventeen states and fourteen cities have representation in this National Board. I hope to see the time when every state and city will be listed. This undoubtedly will be realized, and when that realization is a fact it will be a comforting thought to know that no boilers of any type or for any purpose are built that do not conform with the A. S. M. E. Code. No body of men could appreciate what this would mean more than steam boiler inspectors. A feeling of doubt is eliminated when we know the boiler is of A. S. M. E. Code construction.

Secretary's Report

The secretary, C. O. Myers, read his annual report which is abstracted.

"I am pleased to report that the National Board of Boiler and Pressure Vessel Inspectors has gradually accomplished the results which it set out to do in 1921. In the year of 1923 there were registered 12,820 boilers; in 1924, 13,145; in 1925, 16,170, and in 1926, 20,745.

"The question of statistics on boiler accidents, causes and the types of boilers is the greatest problem before us today. There is no means of collecting authentic statistics other than through an organization of this kind. I would suggest that a standard form of questionnaire be prepared upon statistics. I am pleased to report that the State of Ohio has changed its boiler inspectors' examination dates to correspond with those of New York and Pennsylvania, which are in March, June, September and December."

E. W. Farmer, statistician, then read his annual report which follows in part:

"In presenting the annual report in regard to accidents to boilers and pressure vessels and casualties attended thereby, I deplore the fact that I have been unable to obtain figures as to the actual number of accidents in code states. Therefore, no comparison can be made between boilers constructed to standard regulation and those that are not. I have not included the report of all the industries and the amount of horsepower used. Questionnaires were not forwarded to non-code states, as they have always replied that their states had no departments to keep such records.

"The accidents that have occurred this year have all been on boilers and pressure vessels which were non-code.

"A report just issued by the Geological Survey shows that in 1919 the central stations and electric railway plants of the United States produced 38,921,000,000 kw.-hr.; in 1925, 65,875,000,000, and in 1926, 73,791,000,000.

"In 1919, 35,100,000 short tons of coal, 11,050,000 bbl. of oil and 21,406,000 thousand cubic feet of gas were consumed in the fuel operated electric plants of the country. In 1926, 41,311,000 short tons of coal, and 53,207,000 thousand cubic feet of gas were consumed, but the consumption of oil had fallen to 9,399,000 bbl.

F. A. Page gave an interesting talk about his unsatisfactory experience with welded pressure vessels. The morning session was adjourned after Mr. Obert described the procedure in registering power boilers.

The afternoon meeting was called to order at 2 o'clock. A. P. Applebaum, assistant technical manager, the Permutit Co., read an instructive paper on "The Behavior of Materials Used in Boiler Construction When Subjected to Service Conditions." This paper was illustrated by lantern slides.

M. F. Nicholson, Chief Factory Inspector of the State Department of Labor, spoke about the conditions encountered in the work of that department. He demonstrated that a boiler inspector law was very much needed for Tennessee.

C. R. Texter, Metallurgical Department, National Tube Co., read an interesting paper on the subject "Corrosion, Its Cause and Prevention." The closing paper of the first day was on the subject of "Destructive Effects of Free Oxygen in Steam Due to Its Decomposition During Superheating."

This paper was read by Mr. Anderson McPhee, of the Foremost Superheater Co., in the absence of its author, E. A. Goehegan. The evening was devoted to an informal dinner at the Hotel Hermitage.

The morning session of June 15 was given up to the reading and discussion of several papers. S. W. Miller, Union Carbide and Carbon Research Laboratories, Inc., presented a paper on "Fusion Welding on Boilers and Pressure Vessels." Prof. T. McLean Jasper, Director of Research, A. O. Smith Corporation, read a paper on the "Application of Electric Arc Welding to Heavy Vessel Construction." A. F. Jensen, President, Hanna Engineering Works, read a paper on "The Dependability of the Riveting Art," which was illustrated by motion pictures.

The afternoon was taken up by a sight-seeing tour of the City of Nashville which terminated at the Southern Country Club, where an old-time Southern barbecue was served.

The third day in its entirety was devoted to executive meetings and the election of officers.

The officers elected for the next two years are: C. D. Thomas, Salem, Oregon, chairman; W. H. Furman, New York, vice-chairman; C. O. Myers, Columbus, Ohio, secretary-treasurer; and L. C. Peal, Nashville, Tenn., statistician.

Properties of Methyl Chloride*

By H. J. MACINTIRE, C. S. MARVEL and STANLEY G. FORD

THE rapid development of the fractional tonnage refrigerating machine has brought out the need of a refrigerant that will be safe when the machines are distributed among a class of persons who are ignorant of the refrigerating cycle and its possible dangers, one that operates with an air-cooled condenser without excessive condenser pressure, disintegration, corrosion, etc., and that will have only a nominal piston displacement per ton of refrigeration. The answer to these specifications to a lesser or greater extent has heretofore been sulphur dioxide, apparently because this refrigerant became firmly entrenched before others were investigated.

Compressor Displacements

One of the important considerations in choosing a refrigerant is the piston displacement per unit of refrigeration, especially where space is limited, as it frequently is with the fractional tonnage compressors. As a means of comparison theoretical calculations of the piston displacements per ton of refrigeration per minute using 5 and 86 deg. F. for the evaporating and the liquefaction temperatures respectively are given in the table. The last column shows the displacement using the various refrigerants referred to that of carbon dioxide as unity, whereas the sixth and seventh columns show the suction and the condenser pressures for these operating temperatures. The piston displacement per ton of refrigeration per minute using sulphur dioxide is 9.08 cu.ft., whereas that of methyl chloride is 6.49, so that a compressor using methyl chloride would have a capacity of nearly 50 per cent more refrigeration than a similar one would have using sulphur dioxide. However, the methyl-chloride condenser pressure, as well as the suction pressure, would be considerably more than that of sulphur dioxide. In no case in temperate climates does the condenser pressure exceed 150 lb. if the condenser is an efficient one and the amount of air circulated through it is sufficient in amount.

The fact that one refrigerant has a greater condenser pressure than another is of little moment except from the viewpoint of leaks. The work of compression with the various refrigerants does vary slightly in amount per unit of refrigeration, but the actual amount of this variation is hardly a factor except in the case of carbon dioxide. Where the pressure keeps below 200 lb., the difficulty in keeping the system tight is a slight one if the kind of joint used is satisfactory.

Type of Accessories

Small refrigerating machines, where service is frequently of considerable proportional expense, should be designed with short pipe connections, drop-forged fittings and tongue-and-groove flanges. Under these conditions leaks will become a minimum if a suitable packing is used on the compressor rod. The ability to detect a leak by the smell or preferably by some indicator, as is possible with ammonia and sulphur dioxide, is convenient but not essential if the design permits an elimination of leaks. At present no convenient chemical can be used to detect methyl chloride.

There is no disintegration of methyl chloride except at high temperature, and the corrosion due to this refrigerant is as slight as it would be in the presence of other neutrals like benzene, even when such metals as zinc, lead and cast iron are present. Sulphur dioxide, however, corrodes badly in the presence of water, so that the charge of refrigerant and the oil must be anhydrous. Methyl chloride will not mix with water, and if water is present it will freeze at the expansion valve, so that a suitable dehydrator using granulated calcium chloride should be kept in the pipe line until all danger due to water has been eliminated.

Requirements of an Ideal Refrigerant

An ideal refrigerant should be a non-combustible or a non-explosive, and it should have no bad effects on animal life. Sulphur dioxide is a non-combustible, but it is very painful to breathe even in small proportions in the air. Its effect on people is more severe than is ammonia, whereas methyl chloride is not harmful unless it is inhaled for a considerable time. There is no particular effect due to methyl chloride should it happen that a large quantity be blown into one's face, provided no liquid is present. Occasionally, stories have appeared of sickness caused by relatively small amounts of methyl chloride, but such incidents are without question occasioned by mixtures of methyl chloride and something else or by impurities in the gas. Methyl chloride will burn and with certain limited mixtures it will explode, but the danger due to this is very small.

In considering methyl chloride as a refrigerant some properties which need to be known are its stability toward heat, its corrosive action on metals, its effect on the viscosity of oils, the effects of dissolved oils on its boiling point, its toxicity and the tendency of air and methyl chloride to form explosive mixtures.

Methyl Chloride Characteristics

Several investigators mention that methyl chloride is relatively non-poisonous. Regnauld and Villijean report in some detail on this property. They found that when mixed with air, twice as much methyl chloride as chloroform is needed to produce insensibility and that when the test patient is removed from the exposure to the gas, consciousness returns almost at once. Other statements in the literature place its power of producing anesthesia at one-fourth that of chloroform.

Saposhnikov, in studying various mixtures of air and methyl chloride, found that the limits of combustibility are 10 to 15 per cent of methyl chloride in 85 to 90 per cent of air.

Dumas and Peligot report that dry methyl chloride is completely decomposed into hydrocarbon gases, carbon and hydrogen chloride when it is passed through a porcelain tube heated to cherry redness. Very little further information concerning its stability toward heat has been published.

Since oil and methyl chloride are miscible, some oil may be carried along with the refrigerant into the expansion chamber. This will have an effect on the boiling point of the liquid in the expansion chamber and thus show some effect on the temperatures that can be reached in the refrigerator. Pure methyl chloride at ordinary pressures boils at 9.4 deg. F. Addition of oil increases this temperature less than might be expected, since a mixture of 50 per cent each of oil and methyl chloride boils at about 4 deg. F.

A review, then, of the chemical properties of methyl chloride shows that it is very stable, non-corrosive, not easily inflammable and relatively non-toxic, and hence from the chemical viewpoint should be very suitable for use as a refrigerant.

*Abstract of paper presented at the Spring Meeting, American Society of Refrigerating Engineers, White Sulphur Springs, W. Va., May 25, 1927.

COMPARISON OF REFRIGERANTS

Refrigerant	Total Heat of Saturated Vapor at 5 Deg. F., B.t.u.	Heat of Liquid at 86 Deg. F.	Net Refrigeration per Lb. of Refrigerant, B.t.u.	Sp. Vol. of Saturated Vapor at 5 Deg. F., Cu.ft.	Piston Displacement per Ton per Min., Cu.Ft.	Pressure at 5 Deg. F., Lb. per Sq.In. Abs.	Pressure at 86 Deg. F., Lb. per Sq. In., Abs.	Piston Displacement per Ton per Min. CO_2 Being Taken as Unity
Ammonia	613.3	138.8	474.4	8.15	3.44	34.3	169.3	4.3
Carbon dioxide	101.0	36.5	64.5	0.258	0.80	32.9	104.54	1.0
Sulphur dioxide	183.5	42.1	141.4	6.42	9.08	11.8	66.45	11.34
Ethyl chloride	163.5	21.0	142.5	16.18	22.7	4.5	27.4	28.35
Methyl chloride	171.1	27.7	143.3	4.65	6.49	21.0	95.5	8.11
Butane	165.4	16.0	149.4	10.0	13.4	11.0	42.9	16.75
Propane	159.8	17.8	142.0	2.4	3.38	43.9	159.0	4.22

News in the Field of Power

United Gas Improvement Buys Day & Zimmermann

The United Gas Improvement Co. has obtained, subject to formal approval of the stockholders, a controlling interest in Day & Zimmermann, Inc., 1600 Walnut St., Philadelphia. The firm is interested in and operates public utility properties in 14 states, serving approximately 935 communities, with a population of 2,369,000. Gross earnings of the larger properties under Day & Zimmermann management approximated $34,000,000 last year.

There will be no change in the method of conducting the business of the firm according to statement by Arthur W. Thompson, president of the United Gas Improvement Co., which will continue under the direction of Messrs. Day and Zimmermann.

The corporation is engaged in the general business of engineering and construction, special investigations, appraisals and reports, and management of public utilities and industrial enterprises in the Union and in South America and Europe.

Properties Now Under Control

The National Public Service Co., a holding company, which through its subsidiaries in New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, Georgia and Florida furnishes electric light and power, gas, steam and electric railway, bus, ice and water service to 874 communities with a population of 2,139,000 and consolidated gross earnings of $27,788,600.

The General Public Utilities Co., which furnishes directly or through its subsidiaries electric light, ice and water to 60 towns in the States of Florida, Louisiana, Texas, New Mexico, Arizona and South Dakota, with an aggregate population of about 200,000 and gross earnings of $4,055,000.

The Southern Ohio Public Service Co., which is an operating company serving the City of Zanesville, Ohio, with electric light and power and street railway, and a bus or interurban system, with a population of about 30,000 and gross earnings of $1,546,800.

Day & Zimmermann, Inc., was established as a partnership in 1902. John E. Zimmermann is president.

Franklin Institute To Move to Swarthmore Campus

Decision to remove the research laboratories of Franklin Institute from their present location on North Nineteenth Street, Philadelphia, Pa., to the campus of Swarthmore College, was reported June 5 with a prediction by Dr. Howard McClenahan, secretary of the Institute, that the laboratories would become one of the noted research centers of the country.

It was only recently announced that Dr. W. F. G. Swann, who for the last two years has been the head of the department of physics at Yale University and director of the Sloane Laboratory there, would in September become director of the Franklin Institute Laboratories.

Franklin Institute had leased a corner of the Swarthmore campus for its new building, but there had been no merger of the institute with the college, Dr. McClenathan said.

Seattle A.S.M.E. To Discuss Coast Power Problems

The Seattle Section of the American Society of Mechanical Engineers in cooperation with the other A.S.M.E. sections on the Pacific Coast, is planning a meeting, Aug. 29-31, which will give mechanical engineers an opportunity to discuss the technical problems involved in Pacific Coast industries and will also permit visitors from the East to become acquainted with the tremendous industrial developments in the Northwest.

On Monday, Aug. 29, in the morning the Council will meet and there will be technical sessions. In the afternoon there will be inspection trips to the Boeing Airplane Co. and the Washington Iron Works, followed by a short drive to Alki and around the many boulevards. There will also be a special drive for the ladies and a visit to the Smith Building tower. In the evening there will be a theater party.

On Tuesday technical sessions are scheduled for the morning, with shopping tours for the ladies. In the afternoon the members will inspect the Smith Cove Terminals and electrified sawmill at Ballard. There will also be a boat trip through the Locks, returning by cars around boulevards and through campus of the University of Washington. A dinner dance will complete the day.

The entire day on Wednesday will be given over to a combined water and automobile trip which will take in Bremerton, Shelton, Tacoma, Seabeck and the Hood Canal. Details for this trip have not been completed, but will include either a picnic or a shore dinner.

Engineers Honor Lindbergh

Col. Charles A. Lindbergh, idol of nations, has flown, or rather has been wafted, into another field.

The American Association of Engineers, in the opening session of its annual convention at Tulsa, Okla., June 6, passed a resolution commending Colonel Lindbergh, for his feat in flying alone from New York to Paris and giving him honorary life membership in the Association.

St. Louis in War on Smoke Subscribes $252,600

In a recent financial drive to provide funds for conducting a three-year campaign of smoke prevention, St. Louis raised $252,600, exceeding by $2,600 the preliminary estimate of requirement.

So far as known, this is the largest single amount raised by any city in the United States for smoke abatement. The money will be used to finance a three-year campaign, starting Oct. 1 this year. The present organization will carry on the work up to that time, when it will be expanded to a force of 35 to 40 men, as indicated in the proposed annual budget reproduced in the accompanying table.

Supervisors for 8 Districts

The plan is to divide the territory, including the City of St. Louis and suburbs, and the cities on the east side of the river, into eight districts. Each district will be in charge of a supervisor who will be a permanent employee, becoming thoroughly familiar with smoke conditions in his district. During the heating season each supervisor will have three or four instructors working under him. These men, totaling 24, at an aggregate outlay of $21,600, will co-operate with owners and operators of heating plants, giving firing instructions and maintaining constant supervision of the territory. In the prevention of industrial and railway smoke the League will co-operate with the city smoke department.

The firing school to be conducted at a cost of $7,500, established last year by the coal, coke, furnace and boiler industries, has been turned over to the Citizens' Smoke Abatement League, organized about a year ago, and it will be operated as an important part of the program.

Institutes Soot-fall Study

Free instructions in the proper operation of heating plants will be given to all interested and special classes will be conducted for janitors. Two Ringelmann chart observers will carry on the survey work, making the soot-fall study through the heating season and observations on smoke conditions from all classes of plants.

An annual amount of $3,600 will be set aside in the budget for research work, which will be devoted largely to the proper burning of fuel in the domestic furnace. Also a small sum will be provided annually for publicity and educational work.

The administrative staff will consist of a consulting engineer, executive secretary and publicity man, with the necessary stenographers, for whom salaries approximate $15,900 per year. The proposed budget reaches an annual total of $75,100.

Smoke Prevention Men To Meet at Des Moines, Iowa

From June 27 to 30, inclusive, the Smoke Prevention Association will hold the annual convention at Des Moines, Iowa. The principal events on the program follow:

"Handling the Municipal Smoke Problem," by Gordon D. Rowe, chief smoke inspector, Cincinnati; "Powdered Coal—An Abatement of the Smoke Nuisance," by W. M. Maish, secretary, American Process Co., Des Moines; "A Pound of Coal," by Harry Clewer, superintendent of equipment, Chicago, Rock Island & Pacific Railroad; "Abating Smoke from the Apartment House," by Thomas Casserly, Weil-McLain Co., Chicago; "Burning Iowa Coal," by Prof. Burton P. Fleming, Department of Mechanical Engineering, University of Iowa; "A new Improved Method of Burning Coal," by Henry Vick, Kokal Stoker Corp., Chicago; "Iowa, Its Coal and Smoke," by Royal H. Holbrook, combustion engineer, Iowa State College; "Combustion Engineering Service Furnished by the Illinois Coal Operators," by V. G. Leach, combustion engineer, Peabody Coal Co., Chicago; address by Robert R. Gordon. commissioner of smoke regulation St. Louis; motion pictures, "The Story of Coal"; address by Joseph M. Lonergan, sanitary advison, Department of Health, New York City; "The Brick Arch — Its Relation to Smoke Abatement," by A. M. Sucese, Chicago; "The Back Pressure Gage—Its Bearing on Fuel Economy and Smoke Reduction," by F. J. Bryant, Monon Railroad, Lafayette, Ind.; address by J. B. Hurley, president of Traveling Engineers Association, Wabash Railroad, Decatur, Ill.; "What Can the Engineer and Fireman Do To Prevent Smoke?" by Harry Clewer, Chicago, Rock Island & Pacific Railroad, Des Moines; "Good Firing Practice," by B. T. Feeney, Illinois Central Railroad, Chicago; "Co-operation by the Railroads with the Commissioner of Health, Department of Smoke Abatement" by E. J. Summers, Chicago, Milwaukee & St. Paul Railroad, Chicago; address by D. Coughlin, general manager, First District, Chicago, Rock Island & Pacific Railroad.

I.E.C. Delegates to Italy for Varied Program

Those engineers attending the International Electrotechnical Commission meeting to be held in Italy next September, will enjoy an unusual experience in visiting the more important cities of that country and inspecting recent progress in power development and management.

Delegates are due at Bellagio on Lake Como, Sept. 4, thence by way of Milan, Venice and Florence, they will proceed to Rome, arriving there for the plenary meeting of the I.E.C., Sept. 21.

Solemn commemoration of Volta at Lake Como, on the occasion of the meeting of the Scientific International Congress, will be held Sept. 8, and an excursion to the hydro-electric plants, offered by the Edison Co., will be conducted three days later. The delegates will leave by a special train for Milan, Sept. 13, where they will be the guests of the Milan Section of the Associazione Elettrotechnica Italiana. A visit to the plants at Santa Croce will follow a day in Venice, and Rome will be reached Sept. 19, after a short stay in Florence. The plenary meeting of the Commission in the Immortal City will complete the program Sept. 21.

Guy E. Tripp, Chairman of Westinghouse Board, Dead

Guy Eastman Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Co., one of the foremost exponents of superpower as an aid to industrial and social progress, died shortly before 7 p.m., June 14, in the New York Hospital, New York City, as a result of complications

Guy Eastman Tripp

following an intestinal operation three months ago.

Mr. Tripp, one of the most important executives in American industry, was born in Wells, Maine, April 22, 1865. In 1897 he joined Stone & Webster. He rose to the vice-presidency of the Stone & Webster Management Association and the Stone & Webster Engineering Corp. When, in 1910, the firm was called into consultation on the affairs of the Metropolitan Street Railway Co. of New York City, then in the hands of receivers, Mr. Tripp was appointed their special representative and later was made chairman of the joint committee on reorganization. At the auction of the Metropolitan's property in December, 1911, Mr. Tripp, acting for the bondholders' committee, purchased it for $12,010,000.

Mr. Tripp's handling of the complexities involved in the reorganization of the traction company proved his executive genius and led to his selection in January, 1912, as Chairman of the Board of Directors of the Westinghouse Electric & Manufacturing Co.

During the World War Mr. Tripp was selected by the War Department to solve the problem of purchasing $16,000,000,000 worth of war material. As chief of the Production Division of the Ordnance Department he reorganized the method of such purchasing and accomplished the task assigned him with the same conspicuous success that had distinguished his labors in peaceful industries.

During the last few years Mr. Tripp had been particularly concerned with the future of electrical development of the United States. Convinced by his wartime experience that power is an essential factor in our prosperity, he made an exhaustive study of the situation in the United States in regard to the generation, transmission, and distribution of power.

Mr. Tripp served before his death as a director for 26 companies; and he held membership and active interest in 16 clubs and 21 professional societies and organizations.

Enlists Foreign Scientists for Next Coal Conference

Dr. T. S. Baker, president of the Carnegie Institute of Technology, Pittsburgh, sailed for Europe from New York on June 10, to perfect plans for the second International Conference on Bituminous Coal to be held in Pittsburgh some time in November 1928. He will land at Bremen, Germany and tour the capitals of Europe to renew contacts with the world's leading coal technologists.

In an interview with McGraw-Hill representatives on the eve of his departure, Dr. Baker predicted that the new conference would eclipse in attendance and importance the highly successful first conference of last November which astonished Pittsburgh with a profusion of learned papers dealing with every phase of coal processing and an attendance of 1800 technical delegates. These came from fifteen countries. England, France and Germany, in particular, made outstanding contributions to the success of the conference.

To See Dr. Bergius

In view of this auspicious start, Dr. Baker expects little difficulty in enlisting the co-operation of foreign scientists and inducing the important industrial countries to appoint official delegates at an early date. He plans to confer with Dr. Bergius of Heidelberg, inventor of the revolutionary Bergin process for the direct liquefaction of coal, with General Patart of Paris, who developed one process for the manufacture of synthetic methanol (wood alcohol). He will also see Dr. Fischer whose name is associated with the much-talked-about German methanol process and Dr. C. H. Lander of London, head of the Board of Fuel Research for Great Britain. All of these scientists played prominent parts in the first conference.

It will be the aim of the second conference, said Dr. Baker, to cover the advances made in the intervening two years. The conference will feature the problem of nitrogen fixation for agricultural purposes.

Much interest in this coming event has already been shown, according to Dr. Baker. All concerned, he said, seem to appreciate such an opportunity to keep the research workers of Europe and America in touch with American men of affairs.

Another announcement by Dr. Baker referred to the new Coal Research Laboratory to be established at the Carne-

gie Institute. The first unit, which will get into operation this fall, will be manned largely by chemists. This staff will do work of a fundamental nature, giving due consideration to the theoretical aspects of the work. The demand for fundamental knowledge about coal and coal products was emphasized at the last conference. One of the specific projects for early consideration by the Coal Research Laboratory will be a chemical and physical study of low-temperature tars. The laboratory will avoid duplicating the work of other investigators.

While in Europe Dr. Baker hopes to pick up valuable suggestions as to the constitution of this laboratory and the problems to be studied.

Smithsonian Offers Home to Small Corliss

An early Corliss engine of the smaller type would be a much appreciated contribution to the Smithsonian Institution at Washington, D. C., according to Carl W. Mitman, of the Divisions of Mineral and Mechanical Technology.

That branch of the National Museum devoted to progress in mechanical engineering plans to portray by models, drawings and original apparatus the development of the steam engine, internal-combustion engine, electric motor, locomotive and automobile.

In connection with the steam phase of this permanent exhibit the department contemplates primarily the utilization of a series of models to show the early attempts of Hero, Branca, Savery, Newcomen, and Watt, using in the last case a full-size reproduction of the engine equipped with sun-and-planet gearing. This phase will be followed by a series of objects visualizing engine developments in the United States, and in this is planned to be included a replica of Oliver Evans' high-pressure steam engine, a Corliss engine, a uniflow engine, a single-stage impulse turbine and a turbo-generator assembly.

In the interest of the display depicting the development of the steam boiler the Babcock & Wilcox Co. plans to present the Institution with the Centennial boiler of 1876.

Of special importance in the formation of this mechanical exhibit, emphasizes Mr. Mitman, is the acquisition of a genuine early Corliss of the smaller type. The gift of a good specimen for its preservation in the Institution would be of lasting value and satisfaction to the engineering profession and posterity.

Los Angeles Votes Down Power Bureau Plan

Two measures, advocated by the Los Angeles Power Bureau, providing for the condemnation and purchase by the city of the generating plants, transmission and distribution system of the Los Angeles Gas & Electric Corp., and the taking over of harbor islands by the Power Bureau, were recently defeated by voters with substantial majorities.

Known as Proposition No. 3, one project called for the purchase and operation by the community of the Los Angeles Gas & Electric Corp.'s system, and Proposition No. 4 for the acquisition of the harbor islands for a steam plant, a plan which the Southern California Edison Co. has been fighting in the courts.

Suggestions Simplify Lincoln Arc Welding Contest

As a guide to competitors in the Lincoln arc welding prize for 1927, consisting of $17,500, given by the Lincoln Electric Co., Cleveland, Ohio, and administered by the A.S.M.E., 29 West 39th St., New York City, it has been pointed out that practicable, workable ideas will get more consideration than ideas in which the practicability is open to question.

The problem is to develop or extend the field of usefulness of electric arc welding and make material and labor savings by its use. The object of each entrant should be to make concrete and practical application of the known facts and the principles that have been already established. The application should preferably be made in the field in which the entrant is at present engaged, so that accumulated knowledge in that field will be available and that the chance of the suggestion being impractical will be reduced to a minimum.

Present Uses Listed

To tabulate the general uses of electric arc welding up to the present time, the following classification may be profitably considered:

1. Welding in place of riveting on structural steel shapes and on hot-rolled plate.
2. Replacement of gray iron, malleable, and steel castings with welded steel equivalent, built up from hot-rolled steel plates and shapes.
3. Welding of non-ferrous metals.
4. Welding for maintenance and repair of existing machinery, equipment and structures made of metal.

Entrants in the contest may find applications of these principles in many places, of which the following are merely a few examples:

Steam boilers, pressure tanks, oil stills, air receivers, road-building machinery, steel freight cars, tank cars, bridges and viaducts, steel smokestacks, steel pipe, structural steel for buildings, steel for home building, automobile and truck frames, steel building structures, shipbuilding, gear cases, covers and containers used in machinery vats and chemical apparatus.

Principles for Redesigning

Simple rule-of-thumb methods will enable the entrant to make a start on re-design from gray-iron castings to welded steel construction. For parts where rigidity is the determining factor, build the welded steel equivalent to the castings with the same outline dimensions but with only one-half the thickness of section. Where strength alone is the determining factor, make the steel section one-fourth the thickness of the cast-iron section; and where strength is the important factor, but rigidity a secondary consideration, make the steel sections one-third the thickness of the cast iron section.

The principles of application of electric arc welding described in the preceding discussion are applicable not only to steel, but also to the non-ferrous alloys. The rapidity with which new alloys are being developed and made useful to the industry makes this field of electric arc welding important.

It is now technically possible to weld aluminum, and it appears reasonable to assume that the application may be carried into the aluminum alloys, such as lynite and duralumin.

In welding for maintenance and repair of existing machinery, equipment and structures made of metal, the following fundamental laws should be borne in mind:

a. The great localization of the heat of the welding arc permits welding to be done with a minimum of heat disturbance to the adjacent material.
b. The electrical energy converted into heat by the welding arc appears in the metals being welded. The thermal efficiency of the arc, as a source of welding heat, is very high for this reason, and the heat cost of operation low.

The winners of the prize will be largely selected on the basis of amount of economic saving that the suggestion submitted shows either directly on the design submitted or in its possible wider application. The Lincoln Electric Co. will assist by suggestions or data upon receipt, and further information can be secured from either the company or from the American Society of Mechanical Engineers.

Steam Engineers and Supply Men Hold Elections

Members of the American Order of Steam Engineers meeting for their annual convention at Moose Hall, Philadelphia, June 13 to 16, following a review of the year's activities and outlining plans for the future, elected the following officers for the ensuing year:

Thomas Connell, Philadelphia, supreme chief engineer; R. C. Sinnott, Camden, supreme first assistant engineer; George Farny, Union, supreme recording engineer; W. S. Wetzler, Philadelphia, supreme corresponding engineer; John Kelly, Philadelphia, supreme treasurer; E. H. Wieder, Union, supreme senior master mechanic; Geo. Landis, Progress, supreme junior master mechanic; Emil Maerky, Camden, supreme chaplain; D. M. Sullivan, Camden, supreme inside sentinel; Oscar Kurtz, Germantown, supreme outside sentinel, and Chas. F. Burger, Kensington, supreme trustee.

Results of the elections of the American Supply Men's Association, which was held recently at Philadelphia point into office Harry Schuh, as president, Earnest Buchanan as treasurer, Hugh Edwards as vice-president, and A. Warren France, as secretary.

Celite Wins Decree in Suit

Final decree in favor of the suit brought by the Celite Products Co., manufacturers of Sil-O-Cel heat insulation, against the Featherstone Insulation Co. for infringement of two Celite patents, was awarded by the United States District Court of the Southern District of California, May 13.

May Boiler Production Falls Under Last Year's

May recorded a continuance of the downward course in the productive activities of the manufacturing industry, which trend started in January. May production of these plants was 1.3 per cent under April and was about 4.2 per cent under May of last year. However, corrections for number of working days in April and May established the fact that productive activity during May was only about 0.6 per cent under that recorded during April. Such is the status of productive operations in the boiler manufacturing plants of the nation, as indicated by reports received by *Power* on the monthly consumption of electrical energy by these plants.

Basic reports of electrical energy consumption indicate that general production conditions are very irregular, some of the primary industries of the nation reporting a drop of activity during May of some considerable importance, while others, it appears, were producing at an increased rate over April. Within the industries themselves, and this is applicable to the boiler manufacturing industry, the same conditions appear to exist, some companies reporting increased production, while the industry as a whole is on a distinct downward trend.

Summer Production Expected to Exceed Last Year's

The boiler industry, however, does reflect an opposite tendency from that reported during May by general manufacturing industry. Practically all of the primary industrial groups of the nation appeared to be turning out commodities above the production of May last year, the automobile industry being a striking exception. The boiler manufacturing industry followed the trend of automobile production, the May operations being 4.2 per cent under May of last year.

By reason of the fact that the production of boilers during the last three months has evidently been materially under the same period last year, and due to the fact that the volume of new heavy construction is keeping up with last year, there is every reason to believe that operations in the boiler manufacturing plants taken as a whole during the coming summer months will be of a higher order than was reported during the summer of 1926.

Elwha River Power Resources Are Reported

A report on the power resources of Elwha River, which drains part of the Olympic Range in the State of Washington, has recently been prepared by the Interior Department, through the Geological Survey. This report indicates that the Northwestern Power & Manufacturing Co. is now operating two plants on the river having a total installation of nearly 16,000 kva. and that one of the plants will be, when finally completed, the largest "remote control" power station in the United States.

Two reservoir sites were surveyed having a combined capacity of 75,000 acre-ft., which, if used to store flood waters, will greatly increase the potential power of the river during its low-water periods. Besides the reservoir sites undeveloped power sites were located and described. The total potential power capacity of the river is stated to be about 47,000 hp. during low-water periods of the year, and this can be increased to 81,000 hp. by the construction and operation of the storage sites.

The surveys and examinations were made in 1926 by E. E. Jones, hydraulic engineer. His report, which is a companion paper to similar reports on the power resources of other rivers and streams draining the Olympic Range, is open for inspection at the offices of the Geological Survey at Washington, D. C., and at 404 Federal Building, Tacoma, Wash.

New Orleans A.S.M.E. Founds Annual Student Prize

Establishment of the A.S.M.E. New Orleans Section Prize to be awarded annually to the outstanding senior in the mechanical engineering course of Tulane University was recently announced.

This prize will consist of the initiation fee, one year's dues, junior membership pin and certificate of membership in the society. This senior is to be selected by a committee of three composed of the dean of the Engineering School at Tulane and two professors in the mechanical engineering department.

The first award of this prize has been to John Detzel Haverkamp, Tulane, '27.

New Jersey N.A.S.E. Reports Growth at State Convention

New Jersey members of the National Association of Stationary Engineers held their forty-fifth annual State convention at Plainfield, June 2, 3, 4, and 5.

The secretary reported a marked increase of new members during the year. New associations were instituted in Bound Brook, Hackensack, Long Branch, and another association in Jersey City. The following officers were elected for the year:

Samuel G. Dalrymple, president, John I. Rutherford, vice-president, Thomas M. Gray, secretary, Richard Housman, treasurer, Arthur J. Weiss, conductor and A. B. Kauffman, doorkeeper.

A banquet was held at the Park Avenue Hotel and was attended by many delegates and their wives. John Calahan, of Jersey City, as past national president, was toastmaster.

The 1928 convention will be held at Jersey City, it was decided.

Personal Mention

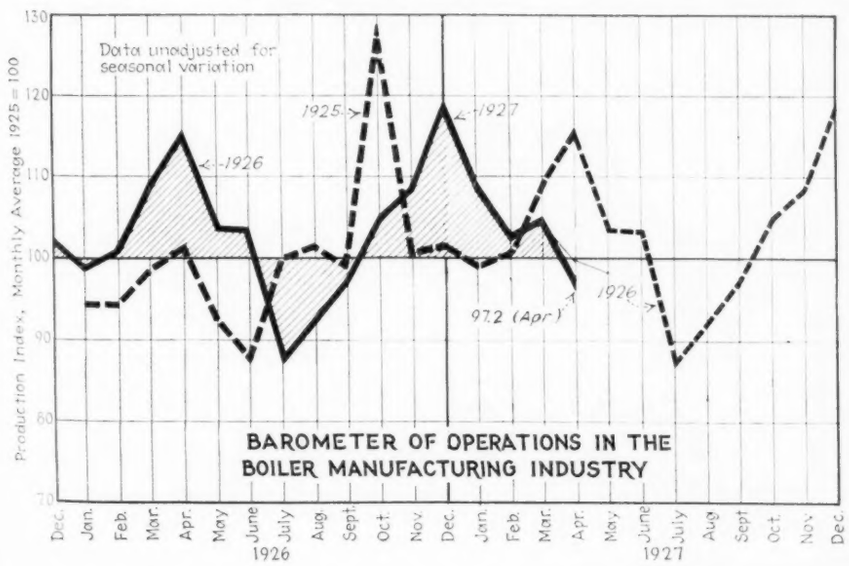
A. D. Skinner, president of the Skinner Engine Co., Erie, Pa., has just returned from a trip to Europe.

W. H. Patchell, past-president of the Institute of Mechanical Engineers of Great Britain, and consulting engineer for several American utilities, sails for New York, Aug. 20.

C. L. Fortescue has been appointed consulting transmission engineer by the Westinghouse Electric & Manufacturing Co. He will concentrate his attention principally upon more fundamental problems of electrical transmission lines in general and will have a consulting relationship with engineering in other departments.

Walter E. Thau, electrical engineer, manager of marine engineering of the general engineering department, Westinghouse Electric & Manufacturing Co., has been appointed director of marine engineering according to announcement made by W. S. Rugg, vice-president of the Westinghouse company. Mr. Thau entered upon his new duties June 1 with headquarters in New York City.

J. Gould Coutant has joined the Walsh & Weidner Boiler Co. He will assist manufacturers of fuel-burning equipment, air heaters, economizers, etc., and prospective purchasers of boilers with their furnace temperature, boiler-gas temperature and heat-balance problems. Mr. Coutant will be located at the company's New York office at 11 Broadway, New York City.



C. O. Maillaux, consulting electrical engineer, of New York City, and honorary president of the International Electrotechnical Commission, sailed June 7 for a month's stay in England and Europe in the interest of the Commission.

C. E. Allen, district manager for the Westinghouse Electric & Manufacturing Co., has been elected president of the St. Louis Electrical Board of Trade, to succeed F. J. Boehm, vice-president of the Union Electric Light & Power Co., it was announced at the meeting of the board, June 7.

Edwin H. Lockwood, authority on heating and ventilation, formerly associate professor of mechanical engineering at Sheffield Scientific School, Yale University, has been appointed by that university as Robert Higgin Professor of mechanical engineering. Besides being a member of the A.S.M.E., Professor Lockwood is a Fellow of the American Academy of Arts and Sciences.

John W. Armitage, formerly with the Chelsea at Atlantic City, recently accepted an offer from the management of the Traymore to become first-assistant to his father, **Geo. T. Armitage,** who has been chief engineer of the latter for a number of years. The many friends of George T. will be pleased to know that he has almost entirely recovered from his recent severe illness and is looking forward to being with them at the N.A.S.E. convention at Los Angeles.

Charles E. Gorton, manager of the Uniform Boiler Law Society and member of the A.S.M.E., hopped off from French Lick, Ind., where he attended the recent meeting of the American Boiler Manufacturers' Association, for a trip around the world. Bound eastward Mr. Gorton will touch at Honolulu, Japan, Shanghai, Singapore, Manila, Hong Kong, Ceylon, Egypt, Palestine and Italy in time for the convention of the International Electrotechnical Commission in September.

Business Notes

The William Ganschow Co. announces the appointment of the Schroer Bros., 2303-2305 Holmes St., Kansas City, Mo., as exclusive representatives in the States of Kansas and Oklahoma.

The Reading Iron Co., Reading, Pa., has announced the appointment of E. W. Thomas, Jr., as representative in the Chicago territory. He will make his headquarters at the company's Chicago office, 449 Conway Building.

The Cochrane Corp. announces the appointment of the Paul B. Huyette Co., Inc., 5 South 18th St., Philadelphia, Pa., as its representative in the sale of Cochrane flow meters in western Massachusetts, Connecticut, eastern New York, eastern Pennsylvania, New Jersey, Delaware and eastern Maryland.

Coming Conventions

American Institute of Electrical Engineers. F. L. Hutchinson, secretary, 33 West 39th St., New York City. Summer convention at Detroit, Mich., June 20-24 inclusive; Pacific Coast convention at Del Monte, Calif., Sept. 13-16.

American Society of Civil Engineers. George T. Seabury, secretary, 33 West 39th St., New York City. Annual convention at Denver, Col., July 13-15.

American Society of Mechanical Engineers. Calvin W. Rice, secretary, 33 West 39th St., New York City. Seattle, Wash. Section, Aug. 29-31.

American Society for Testing Materials. Annual convention at French Lick Springs Hotel, French Lick, Ind., June 20-24; J. K. Rittenhouse, secretary, 1315 Spruce St., Philadelphia, Pa.

National Association of Practical Refrigerating Engineers. Eighteenth annual convention and educational exhibition in Civic Convention Hall and headquarters Hotel Whitcomb, San Francisco, Calif., Nov. 29 to Dec. 2. H. Fox, 5707 W. Lake St., Chicago, Ill.

National Association of Stationary Engineers—Annual convention at Ambassador Hotel, Los Angeles, Calif., Aug. 22-27. Hartford meeting June 24-25, business sessions Saturday morning, aviation flight and banquet. Illinois and Iowa conventions at Rock Island, Ill., June 22-24; secretary, William Hamilton, 719 Main St., Decatur, Ill. Wisconsin convention at Racine, July 19-22, secretary R. L. Scott, 410 Congress St., Eau Claire, Wis.

Universal Craftsmen Council of Engineers. Thomas H. Jones, secretary, 33 Linden Ave., Cherrydale, Va. Annual convention at Buffalo, N. Y. Aug. 2-6.

The C. O. Bartlett & Snow Co., Cleveland, Ohio, manufacturer of elevators, conveyors, driers and complete handling systems, has recently established a district office in Pittsburgh, Pa., at 406 Bessemer Building, which will be in the charge of W. C. Schade.

The Dampney Company of America announces that it has appointed Arthur T. Hunter to represent the company in the sale of APEXIOR coatings in southern Illinois and eastern Missouri, with headquarters at 2083 Railway Exchange Building, St. Louis, Mo.

The Chicago Fire Brick Co., Chicago, Ill., announces that the executive offices have been transferred from the Conway Building, 111 W. Washington St., to the company's new building at 1451-67 Elston Ave., located at the end of its yard No. 1.

The Link-Belt Co. reports that R. P. Shimmin has been appointed assistant to the chairman and the president, and will make his headquarters at 910 S. Michigan Ave., Chicago, Ill.; and that Frank B. Caldwell is now sales manager, with headquarters at the Chicago plant office, 300 W. Pershing Road, and will have supervision over all sales activities in the Western division.

Stevens & Wood, Inc., 120 Broadway, New York City, designers and constructors of the Toronto superpower station, announce the opening of a Chicago office at 53 West Jackson Boulevard, in charge of Lucien I. Yeomans.

The company has been retained by the Board of Transportation, City of New York, to make a complete study, investigation and report on the method to be adopted to provide electric power for the operation of the new municipally owned independent rapid transit lines.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous	Market	June 13
Net Tons	Quoting	1927
Pool 1	New York	$2.50@$2.75
Smokeless	Boston	1.75
Clearfield	Boston	1.65@ 1.85
Somerset	Boston	1.75@ 2.00
Kanawha	Columbus	1.35@ 1.50
Hocking	Columbus	1.75@ 1.90
Pittsburgh	Pittsburgh	2.00@ 2.10
Pittsburgh gas slack	Pittsburgh	1.45@ 1.60
Franklin, Ill.	Chicago	
Central, Ill.	Chicago	
Ind. 4th Vein	Chicago	
West Ky.	Louisville	1.35@ 1.60
S. E. Ky.	Louisville	1.40@ 1.75
Big Seam	Birmingham	1.50@ 1.90
Anthracite		
Gross Tons		
Buckwheat No. 1.	New York	2.25@ 3.00
Buckwheat No. 1.	Philadelphia	2.50@ 3.00
Birdseye	New York	1.30@ 1.60

FUEL OIL

New York—June 16, light oil, tank-car lots; 28@34 deg. Baumé, 5¼c. per gal.; 36@40 deg., 5½c. per gal. f.o.b. Bayonne, N. J.

St. Louis—June 9, tank-car lots, f.o.b. St. Louis; 24@26 deg., $1.65 per bbl.; 26@28 deg., $1.70 per bbl.; 28@30 deg., $1.75 per bbl.; 30@32 deg., $1.80 per bbl.; 32@36 deg., gas oil, 4½c. per gal.; 38@40 deg., 5¼c. per gal.

Pittsburgh—June 1, f.o.b. local refinery; 30@34 deg., fuel oil, 6c. per gal.; 36@40 deg., fuel oil, 6¼c. per gal.

Philadelphia—June 15, 27@30 deg., $2.20½@$2.26½ per bbl.; 13@19 deg., $1.75@$1.81 per bbl.

Cincinnati—June 14, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 6½c. per gal.; 26@30 deg., 6⅝c. per gal.; 30@32 deg., 7c. per gal.

Chicago—June 11, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., 97½c. per bbl.; 26@30 deg., $1.00; 30@32 deg., $1.10.

Boston—June 14, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.35c. per gal.; 28@32 deg., 5.85c. per gal.

Dallas—June 11, f.o.b. local refinery, 26@30 deg., $1.40 per bbl.

Trade Catalogs

Worm Gears and Drives—The Fawcus Machine Co., Pittsburgh, Pa., has published Bulletin E, covering a new line of Fawcus worm speed reducers equipped with Timken roller bearings.

Electric Tachometers—The Brown Instrument Co. Philadelphia, Pa. In the new edition of Catalog No. 45 a new form of centrifugal tachometer, utilizing the inductance bridge principle as a connecting link between the transmitter and the indicating and recording instruments, is announced to tachometer users. With this system, a new form of transmitter replaces the generator, and commutators and brushes are eliminated. Another item of Brown tachometer equipment presented is the inclosed generator.

Fans—The Jeffrey Manufacturing Co. This catalog No. 440 illustrates and describes the special advantage of Jeffrey safeload fans with full back and curved blades for power house and general use where air is required against medium to high pressures. The side disks of this fan are coned and the blades so constructed that when the fan is selected at the proper operating point on the curve, it is impossible to overload the motor. This enables the motor to be used of actual size and the fan to take care of varving conditions—hence the name SAFELOAD fan.

Elevators—The Link-Belt Company of Philadelphia, Chicago and Indianapolis has issued a new publication entitled "Link-Belt Typical Elevators." Book No. 680. The book consists of 44 pages of illustrations, examples, ratings, capacities and tables showing show to select typical elevators. The elevators described in this book are applicable to average conditions for handling practically all materials in bulk. Copies can be had by addressing the Link-Belt Company, 910 S. Michigan Avenue, Chicago.

Disconnecting Switches—Westinghouse Electric & Manufacturing Co. Type RW disconnecting switches designed for 200, 400 and 600 amperes, 7,500 and 15,000 volts, and 400 and 600 amperes, 25,000, 37,000, 50,000 and 73,000 volts by the Westinghouse Electric & Manufacturing Co., is described in Leaflet 20318. General features and advantages are brought out with the aid of halftone illustrations of different designs of switches and diagrams of the various parts of the switches. Tables are also included in this leaflet, giving over-all dimensions for the various types of RW switches, and giving data on insulator flash-over valves. This leaflet may be obtained at any of the district offices of the Westinghouse company or from the advertising department at East Pittsburgh, Pa.

Feed-Water Heaters—Warren Webster & Co., Camden, N. J., in Bulletin 103 treats of Webster feed-water heaters of puddled wrought iron, a standardized line of rectangular and cylindrical heaters built of sheets of old fashioned puddled wrought iron with seamless, leakless welded joints and welded angle bracing throughout.

Supervisory Control—Westinghouse Special Publication No. 1780, recently issued, describes the new panel-mounted supervisory control equipment, giving the outstanding installation features of this apparatus. This publication discusses synchronous visual-type control, the audible-type control, the medium-frequency-type of control and the direct-wire type. Halftone illustrations of the equipment and installations complete this publication, which may be obtained at any of the district offices of the Westinghouse company or from the advertising department at East Pittsburgh, Pa.

New Plant Construction

Calif., Laguna Beach—La Casa de Laguna Hotel Co., J. B. Neil, V. Pres., is having preliminary plans prepared for the construction of a 6 story hotel including swimming pool, etc. at Boulevard and Cliff Dr. Estimated cost $1,000,000. F. R. Spangler, Santa Ana., is architect.

Calif., Livermore—W. R. McKinnon, G. F. Tubbs, et el, c/o G. Ruthforth, 354 Pine St., San Francisco, Archt., is having preliminary plans prepared for the construction of a 4 story hotel at First and L Sts. Estimated cost $500,000.

Calif., San Jose—San Jose Hotel Corp., c/o W. H. Weeks, 369 Pine St., San Francisco, Archt., is having preliminary plans prepared for the construction of a 10 story hotel on West Santa Clara St. here. Estimated cost $1,500,000.

Calif., Saratoga—Saratoga Golf & Country Club, Saratoga, L. D. Allen, Mgr., Cupertino, is having plans prepared for the construction of a 4 story hotel. Estimated cost $1,000,000. W. B. Hoag, De Young Bldg., San Francisco, is engineer.

Conn., New Haven—United Illuminating Co., 84 Temple St., awarded contract for the excavation for power plant on Grand Ave. to Clark-Barone Co., Oak and Wight Sts. Estimated total cost $3,000,000.

Conn., Stamford—Wilson & Co., Jefferson St., awarded contract for the construction of a cold storage plant including electric refrigeration system to Wood Co., 433 Main St. Estimated cost $65,000.

D. C., Washington—Owner, c/o Tillion & Tillion, 415 Lexington Ave., New York, N. Y., Archts., is having preliminary plans prepared for the construction of a 12 story hotel and theatre building, here. Estimated cost $5,000,000. Poggi & Winters, Equitable Bldg., Broad and Locust Sts., Philadelphia, Pa., are associate architects.

Ill., Chicago—Belmont-Sheffield Building Corp., c/o Van Guten & Van Guten, 26 East Huron St., Archts., is having sketches made for the construction of a 6 story hotel, bank and stores building at Sheffield & Belmont Aves. Estimated cost $850,000.

Ill., Chicago—S. F. Koerner, 4103 Belmont Ave., had plans prepared for the construction of a 7 story hotel including electric refrigeration and mechanical ventilation systems, elevators, etc. Estimated cost $500,000. Roos-Wagelein Co., 3106 North Cicero Ave., is architect.

Ill., Chicago—B. F. Lindheimer, 77 West Washington St., is having plans prepared for the construction of a 19 story hotel, theatre and office building at 63rd St. and Maryland Ave. Estimated cost $1,500,000. A. S. Alschuler, 28 East Jackson Blvd., is architect.

Ill., Chicago—Sanitary District of Chicago, 910 South Michigan Ave., will receive bids until July 7 for the superstructure of a pumping station. E. J. Kelly, 910 South Michigan Ave., is engineer.

Ill., Chicago—Syndicate, c/o Oman & Lilienthal, 64 West Randolph St., Archts., will soon award contract for the construction of a 20 story hotel including steam heating system, elevators, etc. at St. Clair and Ohio Sts. Estimated cost $3,000,000.

Ill., Chicago—University Hotel Corp., c/o R. E. Major & Co., 4022 West Madison St., Archts., is having plans prepared for the construction of a 13 story hotel including elevators, etc. at Van Buren and Wood Sts. Estimated cost $1,000,000. Flynt Hotel Corp., c/o H. C. Flynt, 21 North La Salle St., is lessee.

Ind., East Chicago—Albert Given awarded contract for excavation for a 6 story hotel at Chicago and Magoun Sts. Estimated cost $600,000. Private plans.

Ind., Muncie—Muncie Home Hospital, awarded contract for the construction of a hospital to A. Glaser, 616 Mulberry St. Estimated cost $1,000,000.

Ind., South Bend—Schenninger-Ackerman-Allardt Hotel Co., is receiving bids for the construction of a hotel at 218 East La Salle St. Estimated cost $500,000. M. E. Smith, 319 South Main St., is architect.

Md., Cumberland—West Maryland Hospital, W. Brown, Supt., plans the construction of a 6 story hospital. Estimated cost $500,000. Zantzinger, Borie & Medary, Otis Bldg., Philadelphia, Pa., are architects.

Mass., Boston—Institutions Dept., W. S. Kenney, Comr., City Hall, plans the construction of a power and heating plant for Deer Island House of Correction. Estimated cost $125,000.

Mass., West Springfield (Springfield, P. O.)—United Electric Light Co., L. J. Scott, Gen. Mgr., awarded contract for the construction of a switch house including transformer equipment, etc. to Stone & Webster Inc., 49 Federal St., Boston. Estimated cost $600,000.

Mich., Detroit—Michigan Bell Telephone Co., Cass Ave., awarded contract for the construction of a 12 story office building to W. E. Wood Co., 1825 Ford Bldg. Steam heating and ventilation systems, elevators, etc. will be installed.

Mich., Eloise—Wayne County Superintendents of Poor, County Bldg., Detroit, plans the construction of a hospital including steam heating and ventilation systems, boilers, elevators, etc. on Michigan Ave. here. Estimated cost $500,000. F. J. Winter, 2111 Book Tower, Detroit, is architect.

Mich., Saginaw—City will receive bids until June 28 for the construction of a water purification plant and pumping station for waterworks. F. G. Gordon, 53 West Jackson Blvd., Chicago, Ill., is engineer. Former bids rejected.

Mo., Butler—City will soon award contract for waterworks improvements including 1,000,000 gal. storage reservoir, low pressure pumping unit, etc. J. W. Shikles & Co., 708 Union Trust Bldg., Kansas City, Mo., are engineers.

Mo., Kansas City—S. B. Talbert, Continental Bldg., Archt., is preparing preliminary plans for the construction of a 20 story office building at 9th and Walnut Sts. Owner's name withheld.

Mo., Macon—City voted $165,000 bonds for waterworks improvements including impounding reservoir, pumping station, earth and rip rap dam, mains, etc. Burns & McDonnell Engineering Co., 402 Interstate Bldg., Kansas City, are engineers.

Mo., St. Louis—Hotel Jefferson Co., L. T. Hay, Pres., will soon award a contract for the construction of a 14 story addition to hotel at Locust Blvd., St. Charles St. and 12th Blvd. Estimated cost $2,000,000. Teich & Sullivan, 814-816-818 Garrick Bldg., 64 West Randolph St., Chicago, Ill., are architects and T. P. Barnett Co., Arcade Bldg., St. Louis, Mo., is associate architect.

N. J. Elizabeth—Elizabeth Chamber of Commerce Hotel Co., 227 Broad St., will receive bids until June 24 (extended date) for the construction of a 9 story hotel and stores building including steam heating, refrigeration and ventilation systems, boilers, pumps, elevators, etc. at 323 North Broad St. Estimated cost $1,000,000. W. L. Stoddart, 50 East 41st St., New York, N. Y., is architect. H. B. Brady, 333 North Broad St., is associate architect.

N. J., Newark—Merchants' Refrigerating Co., 41 River St., awarded contract for the construction of a 9 story cold storage plant to White Construction Co., 95 Madison Ave., New York, N. Y. Estimated cost $700,000.

N. J., Weehawken—Charles Neilsen Construction Co., Broadway, West New York, is having plans prepared for the construction of a 5 story apartment including steam heating and refrigeration systems, boilers, elevators, etc. at 127-129-131 Parkview Ave. Estimated cost $500,000. Private plans.

N. J., West New York — (Weehawken P. O.)—Burstyn & Hefler, 222 30th St., Woodcliff, is having plans prepared for the construction of a 10 story apartment including steam heating and refrigeration systems, boilers, elevators, etc. on East Blvd. here. Estimated cost $500,000. Private plans.

N. M., San Marcial—Tex-La Power Co., Ft. Worth Club Bldg., Ft. Worth, Tex., plans the construction of a power and light plant here to replace fire loss. Estimated cost $300,000.

N. Y., Albany—Dept. of Health, Capitol, will receive bids in July for the construction struction of a power house, etc.

N. Y., New York—Three Hundred Thirty Three East Sixty Eighth St. Corp., 578 Madison Ave., awarded contract for the construction of a 15 story apartment to Fred T. Ley & Co., 578 Madison Ave. Estimated cost $1,000,000.

N. Y., Raybrook—Division of Standards, Executive Dept., Capitol, Albany, will receive bids in July for the construction of a power house for hospital for the treatment of Incipient Pulmonary Tuberculosis, here.

O., Akron—St. Thomas Hospital, will receive bids until June 22 for the construction of a hospital, nurses' home and power plant. Estimated cost $500,000. F. C. Warner & W. R. McCormack, Bulkley Bldg., Cleveland, are architects.

O., Cleveland—The Gas Products Co., S. D. Winger, V. Pres. and Gen. Mgr., Columbus, awarded contract for the construction of an office building, boiler house, generator plant, etc. on Jennings Rd. here, to Van Blarcom Co., National City Bldg., Cleveland. Estimated cost $60,000.

O., Columbus—Acme Development Co., 17 South High St., D. W. Beggs, Pres., will receive bids until June 30 for the construction of a 12 story office building including three electric elevators, etc. on East Slate St. Estimated cost $700,000. Miller & Reeves, 205 East Broad St., are architects.

Okla., Enid—Banfield Bros. Packing Co., will receive bids until July 1 for the construction of a packing plant including boiler room, etc. Estimated cost $50,000. L. J. Menges, c/o National Packers, Inc., 405 Franklin St., St. Louis, Mo., is architect. G. Birkland, c/o National Packers, Inc., 405 Franklin St., St. Louis, Mo., is engineer.

Okla., Locust Grove—City is having plans prepared for waterworks improvements including pumping plant, mains, etc. Estimated cost $18,000.

Okla., Oklahoma City—Builders Exchange Co., c/o J. B. Lowden, Oklahoma Club Bldg., is having preliminary plans prepared for the construction of a 10 story office building on Grand St. Estimated cost $775,000. Architect not selected.

Pa., Philadelphia—Bd. of Education, J. D. Cassell, Supt. of Buildings, plans the construction of a power house on Byberry St. Estimated cost $500,000.

Pa., Philadelphia—Broad Street Trust Co., 12th and Arch Sts., plans the construction of a 10 story bank and office building at Broad and Stiles Sts. Estimated cost $700,000. Ritter & Shay, Packard Bldg., are architects.

Pa., Philadelphia — Bureau of Yards & Docks, Navy Dept., Washington, D. C., awarded contract for the construction of an automatic refrigeration and cold storage plant at Navy Yard here, to The Frigidaire Corp., 1313 New York Ave., Washington, D. C.

Pa., Philadelphia — Dept. of Public Works, Bureau of Engineering, awarded contract for the construction of a sewage disposal plant and pumping station at Wheatsheaf Lane and Richmond St., to Fred Snare Corp., 1524 Chestnut St.

Pa., Philadelphia—Quaker City Iron Works, awarded contract for the construction of a boiler house at Arammago and Tioga Sts. to Belmont Iron Works, 22nd St. and Washington Ave.

Pa., Pittsburgh—Morewood Gardens Co., c/o Marks & Kann, Home Trust Bldg., Archts., awarded contract for the construction of a 7 story apartment on Morewood Ave. to H. Miller & Sons, 2565 5th Ave. Estimated cost $1,400,000.

Tex., Abilene—O. D. Dillingham, is receiving bids for the construction of a 75 ton ice plant at 14th and Butternut Sts. Estimated cost $100,000. Private plans.

Tex., Houston—J. Finger, Keystone Bldg., Archt., will soon receive bids for the construction of a 10 to 16 story hotel for G. V. Christie, First National Bank Bldg. Estimated cost $600,000.

Tex., San Antonio—Merchants Transfer Co., F. Canaday, Pres., 215 Main Ave., plans extensions and improvements to plant including cold and dry storage warehouses, etc. at Dolorosa Ave. and San Pedro Creek. Estimated cost $1,000,000. Private plans.

Tex., San Antonio — Smith Bros. Properties Inc., Plaza Hotel, awarded contract for the construction of a 14 story hotel annex on St. Marys St. to McKenzie Construction Co., Travis Bldg. Estimated cost $1,000,000. Steam heating, refrigeration and ventilation systems, boilers, elevators, etc. will be installed.

Vt., Castleton — State, J. W. Weeks, Governor, awarded contract for the construction of a dormitory and heating plant, to C. G. Noyes, Rutland. Estimated cost $150,000.

Washington—Potomac River Corp., R. J. Bulkley, Pres., Bulkley Bldg., Cleveland, O., has made application to the U. S. government to make preliminary surveys for a hydro-electric development. Plans include the construction of two 100 ft. dams and power stations, etc., along the Potomac River here. Estimated total cost approximately $60,000,000.

Ont., Oshawa—Hambly Bros., King St. W., are having plans prepared for the construction of an artificial ice arena, ice surface 80x190 ft. Estimated cost $150,000.

Equipment Wanted

Coal Handling Equipment — Sewage Comrs., Milwaukee, Wis., will receive bids until June 24th for coal handling equipment for Dryer House at sewage disposal plant on Jones Island. Estimated cost $20,000.

Engine—West Texas Utilities Co., Abilene, Tex., plans to purchase and install a 1200 hp. engine in power plant at Plainview, Tex.

Engine and Generator—Marion Electric Light & Power Co., Marion, N. D., is in the market for 10 to 30 hp. oil engine and generator, a.c. or d.c.

Generator—The National Power Machine Co., 1933 Scranton Rd., Cleveland, O., is in the market for a 300 or 400 kva. generator, 3 ph., 60 cycle, 2300 v. direct connected to uniflow engine.

Generators—A. E. Mundy, Secy., Brownsville, Tex., will receive bids until July 1 for one 3000 and one 5000 kw. turbo driven generators complete with condenser, circulating pump, switchboard, etc. for proposed waterworks improvements.

Pumping Equipment—City of Gotebo, Okla., will be in the market for pumping equipment for proposed waterworks improvements. Estimated cost $30,000.

Pumping Equipment, Etc.—City of Tylertown, Miss., will be in the market for 2,750-g.p.m. pumping equipment, etc., for proposed waterworks improvements.

Pumps—City of Tipton, Okla., will be in the market for motor driven centrifugal pumps for proposed dam on Otter Creek. Estimated cost $60,000.

Pumps—Transit Dept., 1 Beacon St., Boston, Mass., is in the market for centrifugal pumps for Dorchester Rapid Transit.

Pumps—Borough Council, F. F. Moore, Pres., Homer City, Pa., will receive bids until June 27 for two 300,000 g.p.d. motor driven centrifugal low and high lift pumps, etc. for proposed filtration plant and distribution system.

Pumps — Dept. of Public Works, Pittsburgh, Pa., will soon receive bids for steam turbine driven centrifugal pumps and appurtances for Ross pumping station. Estimated cost $210,000.

Transformers—Dept. of Gas & Electricity, M. J. Kennedy, Comr., City Hall, Chicago, Ill., will receive bids until June 23 for pole type series transformers for 1,000 c.p. lamps for use during 1927 for the maintenance of the municipal street lighting system.

Refrigeration Equipment—Dept. of Correction, 353 Broadway, Albany, N. Y., will receive bids until July 12 for refrigeration equipment for Matteawan State Hospital, Beacon, N. Y.

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